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ALPHEUS S. PACKARD AND EDWARD D. COPE.

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BOULDER MOSAICS IN DAKOTA.

BY PROFESSOR J. E. TODD.

SUCH a name seems best to express the character of certain strange works noticed by the writer upon some of the conspicuous hills of Southeastern Dakota. The term mosaic, though describing better than any other word their structure, may suggest greater delicacy than they possess, but the qualifying epithet sufficiently corrects it.

A typical example, and the first to come to the writer's knowledge, was found on the summit of Keya Kakop, or Turtle point, three miles north of Wessington springs in Jerauld county. The point is a high promontory-like hill standing out on the western edge of the James River valley, above which it rises nearly 500 feet. It is the northern end of a high ridge of drift constituting a well washed interlobular portion of the principal moraine. A view of Turtle point and a portion of the ridge from the northwest is shown in Fig. 1. Upon the highest portion of the point is a low broad mound built of earth, perhaps fifty feet in diameter and three or four feet high. It does not differ materially from many that are found on the summit of bluffs along the James and Missouri. Its chief attraction is the gigantic figure of a turtle upon its southern slope, as is shown in Fig. 2. This figure is formed of boulders, four to six inches in diameter, quite closely and regularly set, so as to describe its outline. The head, legs and tail are extended. Its general appearance, position and structure are shown in Fig. 3. Visitors to the locality will also notice a rude human figure, sketched with similar material, on the south-west side of the mound as shown in Fig. 2, but it is confessedly the work of an early owner of the ground. To one

not informed of the fact its recency would be apparent from the pebbles comprising it lying on the surface of the ground, while those forming the turtle are half imbedded. That it is not of the same origin as the turtle is further indicated by the representation of the legs and arms by *single* rows of stones. The locality was first visited by the writer in 1881, and the figures were intact when seen again in 1883. The figure is about fifteen feet in length from tip of tail to front of head. A little pile of stones lies a short distance in front of the head.

This work, interesting as it is, sinks into insignificance when compared with a similar work upon Paha Wakan, or Medicine hill, near Blunt, in Hughes county. This hill is also a high interlobular portion of the principal moraine, and presents the same general features as Turtle point, as will be seen in a sketch of it, from the east, in Fig. 6. It rises above the surrounding plain about 200 feet, and nearly 400 feet above the adjoining valley of Medicine creek. Its summit is flat and includes many acres. Granite and limestone boulders abound in profusion. Tipi-rings, *i. e.*, circles of boulders which were used in holding down the covering of the conical tents used by the Dakotas, are very abundant upon the summit. A few mounds of ordinary size are scattered in no apparent order. Near the north-western angle of the summit platform is the gigantic figure represented in Fig. 4. Its length measured roughly along its central line, following the crooks, is 120 paces. The general form, with length, breadth and number and shape of crooks, are as faithfully represented as a hasty sketch could give. The boulders composing it are from six to twelve inches in length, and are laid much less closely than in the turtle. The direction of its northern half is N. 18° W. The presence of the mound at its side seems to be accidental. The head is more carefully represented in Fig. 5, where an attempt is made to express the shape, size and position of the boulders composing it. The eyes are much more expressive than it would at first seems possible to make them with such material. They have literally a "*stony* stare." They are formed of two oblong boulders nearly a foot in length. The angular head and heavy body suggest the rattlesnake as the designer's model, but there is no clear representation of the rattles. Perhaps that was beyond the artist's inventive power. At *c*, in Fig. 4, the boulders have evidently been displaced, probably by water or frost action, as

that portion is on an inclined surface. This gigantic serpent was in good condition when seen in 1883.

An examination of similar localities over all Southeastern Dakota has failed to discover any other similar representations of animals. Numerous rude sketches of animals on a smaller scale are found near Pipestone, Minn., chipped or pecked on the smooth surface of the red quartzite. Some of the best of these are exhibited in the Minnesota Geological Report, Vol. I. In these the turtle is a favorite figure, but none are as symmetrically represented as in the one on Turtle point. No serpent is represented among them.

Similarly made figures, but quite imperfect, were noticed by the writer on Wolf creek, south-west of Bridgewater, Dak.

But although no more animal figures have been found, a few other similarly constructed works have been noted. Upon Indian hill, north-west of Valley City, is a rectangular figure between two mounds which may be natural. The sides are remarkably straight and parallel, and the stones, which are four to twelve inches in diameter, are quite regularly laid. The ends are rounded a little. Its form is shown in Fig. 7. It is eighteen paces long and three paces wide. The direction of its sides is N. 78° E. A number of the stones composing it had been lately displaced in 1882 when the writer visited it. The holes in which they had lain were fresh and showed their form clearly.

Upon a high broad terrace of Crow creek, a few rods back and east from a remarkably fine spring which is at the foot of the terrace, and about a mile north-west of the town of Waterbury, is found a somewhat similar figure on a much larger scale; moreover it is incomplete and somewhat irregular. Its outline is shown in Fig. 8. It eastern side is ninety-two paces in length and is directed N. 2° E. The north end is curved slightly, but lies nearly at right angles with the left side, which is directed N. 15° E. At *a* is an opening which may represent a gateway, as an oblique line of stones, sufficient in length to close it, is at one end. Near it and at various other places are small circular pits, two to four feet across. No pains was taken to locate them accurately, as it was thought that they had no special connection with the lines of boulders.

The gap at *d* was probably caused by some recent removal of the boulders for use in forming some tipi-rings not far away. At

b is a circular pit with boulders on its sides and a pile of pebbles in its bottom. At *c* is a triangular pile of stones about three feet on each side. The southern ends of the sides are not far from the side of a ravine. A more careful examination would probably discover other interesting and perhaps more significant relations.

According to Mr. T. H. Null, of Waterbury, who has seen it, there is, on the S. W. ¼, S. 28, 109.66, a cross formed of two lines of boulders. One four rods long is crossed at right angles by another one and a half rods long. At the end of the first, which would correspond to the foot of the cross, is a pile of stones.

Though this completes the list of "boulder mosaics," it may not be out of place to speak of a somewhat related work noted by the writer, in 1881, in Brown county a few miles north-west of Westport. On the right bank of Elm river were two quite conspicuous mounds, 270 paces apart, upon two symmetrical knolls. Beginning at the top of the north-western one, a line of bones extended over the center of the other, and 146 paces beyond, where it ended in a small pile of boulders. The bones were mostly the leg bones of buffalo set up in the ground like stakes. That was before the land was in market. Ere this the plow of the white man has probably removed all trace of them. A few years more and the more enduring "boulder mosaics" will probably help to form the stone wall of some enterprising settler, as careless of the sacred associations attending them as the Turk who builds the fragments of ancient temples into his hovel.

EXPLANATION OF PLATE I.

FIG. 1.—A sketch of Turtle point from the north-west.

" 2.—Plan of mound with figures upon the summit of Turtle point, near Wessington Springs, Dak.

" 3—Enlarged view of the turtle in Fig. 2.

" 4.—Ground plan of the great serpent on the summit of Medicine hill, near Blunt, Dak.

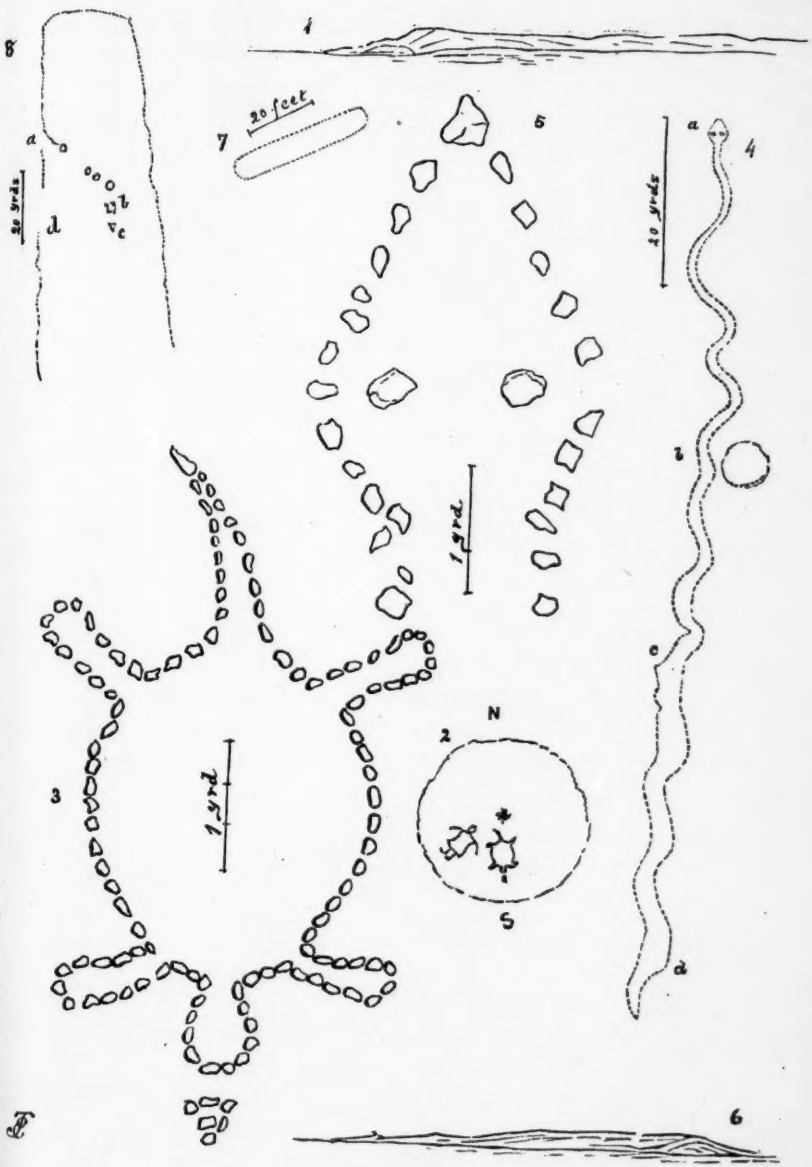
" 5.—Enlarged view of the head of the same.

" 6.—View of Medicine hill from the east.

" 7.—Plan of a figure on the summit of Indian hill, near Valley City, Dak.

" 8.—Plan of a figure near Waterbury, Dak.

NOTE.—The figures are all drawn in their correct position with reference to the points of the compass.



Boulder Mosaics in Dakota.

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A STUDY OF THE DANDELION.

BY E. LEWIS STURTEVANT, M.D.

THE dandelion is a plant of northern climates, especially found growing amidst the herbage of meadows, and as a weed in gardens. Its common name is a corruption of *dent de leon*, a word which is met with in the Welsh *Dant y Llew* of the 13th century. Its vernacular names in various languages have usually reference to the peculiar indentation of the leaves, or to some other resemblance or character of the plant. By commentators it has been identified with the *aphake* of Theophrastus, *a* in composition signifying absence of, and *phake* lentils, or the name perhaps signifying that the plant can be used as a green before lentils appear in the spring (?); the *ambubeia* of Pliny may suggest the scattering of the seed, *ambulo* meaning the going backward and forward, but some commentators assign this name to the wild endive or chicory; the *hedypnois* of Pliny is but doubtfully identified with our dandelion, and appears to be derived from two Greek words signifying sweet breath, and may refer to the sweet smell of the flowers. Pinæus, 1561, calls it *Dens Leonis, Dens Caninus, caput Monachi, Rostru porcinum* or *Ambubeia*, the *aphake* of Theophrastus; by the French, *Pissenlit* or *Dent de Lyon;* by the Germans, *Pfaffen roerlin.* Pena and Lobel, 1570, give additional names of *Urinaria*, German *Korlkraut* and *Phaffenblat*, Belgian *Pappen cruyt*, English *Dent de Lyon.* The modern vernacular names are: English *dandelion, swine's snout* (Prior); France *pissenlit, dent-de-lion* (Vilm.); German *lowenzahn* (Lenz); Flanders *molsalaad* (Vilm.); Danish *moelkebtte* (Vilm.); Italian *tarassaco* (Lenz), *dente de leone, virasole dei prati* (Vilm.); Spanish *diente de leon, Amargon* (Vilm.); Greek *agriomaroulia* (Sibth.), *pikraphake* (Fraas); Japanese *fosei* or usually *fudsina* or *tsugumi gusee* or *tampopo* (Pick.).

Bauhin, in his Pinax, edition of 1623, enumerates two varieties of dandelion, one the Dens Leonis latiore filio carried back in his synonomy to Brunselsius, 1539; the other, Dens Leonis angustiore folio, carried back in like manner to Cæsalpinus, 1583. The first kind, he says, has a large and a medium variety, the leaves sometimes pointed, sometimes obtuse. In the Flore Naturelle et Economique, Paris, 1803, the same varieties, apparently, are mentioned, one with narrow leaves and the other with large

and rounded leaves. In Martyn's Millers Dictionary, 1807, the leaves of the dandelion are said to vary from pinnatifid or deeply runcinate in a very dry situation to nearly entire in a very moist one, generally smooth, but sometimes a little rough, and *Leontodon palustre* is described as scarcely more than a variety, as varying very much in its leaves which have few notches or are almost entire, the plant smoother, neater, more levigated and more glaucous than the common dandelion. In Geneva, N. Y., on the grounds of the New York Agricultural Experiment Station, a large number of varieties are to be commonly noted, both in the habit and appearance of the plant and irrespective of difference of soil or exposure, as varieties may readily be separated whose roots are intertwined. Some plants grow with quite erect leaves, others with their leaves closely adpressed to the soil; some have broad, others narrow leaves; some have runcinate leaves, others leaves much cut and almost fringed, and yet others the leaves nearly entire; some have almost sessile leaves, some have smooth leaves, others roughened leaves; some have thin, others thick leaves; some as varieties grow to a larger size, others are always dwarfer; some have an open manner of growth, others a close, etc.

The use of the wild plant as a vegetable seems to have been common from remote times, but its culture is modern. In 1836 a Mr. Corey, of Brookline, Mass., grew dandelions for the Boston market, the seed obtained from the largest of the wild plants (Mass. Hort. Soc. Trans., 1884, 128); in 1863 dandelions are described among garden esculents by Burr (Field and Gard. Veg. of America, 345), but the context not indicating any especial varieties; in 1828 Fessenden (New Am. Gardener) says the wild plant is used but never cultivated. In 1874 the seed appears for sale in seed catalogues (Briggs Bros. Cat., 1874), perhaps earlier, and the various seed catalogues of 1885 offer six names, one of which is the "common." In England, dandelion culture is not mentioned in Mawe's Gardiner, 1778, nor in Martyn's Millers Dictionary, 1807; the first notice I find is in the Gardeners' Chronicle, 1846 (p. 340), where an instance of cultivation is noted, the herbage forming "a beautiful and delicate blanched salad." In 1880 its culture had not become common, as this year its cultivation in France, and not in England, is noted (Jenkins Jour. R. A. S., XVI, 94). In France, Noisette, 1829 (Man. du Jard., 1829, 356) gives cultural directions, and says the wild plant fur-

nishes a spring pot-herb; the plant is, however, not mentioned in L'Horticulteur Francais, 1824–5, nor in Nouveau Dictionnaire du Jardinage, 1826. Vilmorin (Bon Jardinier, 1882) states its culture in France as dating from 1868, and the firm of Vilmorin, Andrew et Cie in 1885 offer four sorts of seed, one, the "improved moss" as new. In Vilmorin's Les Plantes Potageres, 1883, two forms are figured, Pissenlit ameliore a cœur plein and Pissenlit ameliore tres hatif. The first of these is named in Album de Cliches, Pissenlit ameliore frise, and a fourth name or third form is figured, the Pissenlit mousse.

1. The type of the Pissenlit mousse can be readily found among the wild plants of the station grounds, very closely resembling Vilmorin's figure in every respect when growing on rich soil except that the leaf divisions are scarcely as much crowded.

2. The type of the Pissenlit ameliore a cœur plein is perhaps to be recognized in Anton Pinæus' figure, 1561, and is certainly to be found growing wild at the station.

3. The Pissenlit ameliore tres hatif is figured in 1616, the resemblance between the two figures, the one by Dodonæus and the other by Vilmorin, is very close. It is also to be found growing wild on the station grounds.

The influence of rich soil and protected growth upon the dandelion is to give increased size and succulency to the plant, and to thicken the branching of the leaves, in the direction of answering the description of *a cœur plein;* but this influence appears to be limited by the heredity of the plant, as the types do not react to an equal extent. This fullness or hearting in No. 2 seems to come from the strong tendency in plants of this type to divide the root into a group of crowns; the leaves, also, in rich soil, grow rather upright with the upper portion curving outwards, giving a curled appearance to the plant, and thus justifying Vilmorin's alternate name "frise." The No. 3 form is more succulent in rich soil than the others, attains size distinctly earlier, is less crowded and less upright in growth, and in some cases is very closely adpressed to the ground. No. 1 type does not in all cases seem to be a depauperate form, as it is found on fertile soil along with the rest, it is usually small, but in some instances is of fair size and quite bunchy growth. A form with nearly entire leaves has not yet reached culture under a distinct name; this type is distinctly smaller than the rest, and some plants have

sessile and thickened leaves, other plants long petioled and spatulate-like thin leaves. In all the forms some plants may be looked for with hairy and roughened leaves.

In view of the limited extent of the present culture of the dandelion, and the short time since its cultivation was first attempted, as well as to the fact that its present culture about Geneva seems unknown, it seems unreasonable to infer that our plants are escapes from cultivation, and much more so when it is considered that these same described types are common elsewhere in Western New York. If not escapes from cultivation the inference seems strongly established that our cultivated varieties did not originate under cultivation, but are simply selections from wild types. If this be granted it may be legitimately questioned whether other of our cultivated form-species in other plants are not likewise of natural origin.

A careful investigation into the history of the origin of our cultivated varieties fully justifies the statement that I have as yet secured no data which justifies the belief that form-species in culture are other than of natural origin, and I have secured much evidence in favor of the view that form-species are introductions from natural variations. Before, however, such a radical belief can receive countenance, much must be done in the herbarium study of varieties as collected from various sources, in order that we may have wild forms to which our cultivated types can be referred. Our so-called modern vegetables, introduced as novelties, often seem to be such only because we are unfamiliar with what our predecessors possessed. Thus the figure that Pinaeus gives, in 1561, of a lettuce answers to our stone tennis-ball variety as closely as do the figures in our seed catalogues to the varieties whose name they carry; the deer-tongue lettuce introduced as a novelty in 1883 seems nearly identical with the Lactuca folio oblongo acuto of Bauhin's Prodromus, 1671; a large number of our capsicums or peppers seem to be identical with the varieties figured in Hortus Eystettensis, 1623; new types of squash followed the appearance of the Valparaiso from Chili in the early part of the present century, etc., etc.

Under the hypothesis that the form-species of cultivation are originally from nature, we can explain the permanency of these form-species, and their resistance to change from cross fertilization, the tendency seeming strongly towards trueness to type, and the purging themselves from contaminations unless restrained

perhaps by human selection. Thus two form-species of maize, when crossed, have not produced intermediates in their crop, but the parent types without intermediates, and the continuous planting of the progeny tended toward a complete separation into the original types. Various crossings of a like kind, made at the Experiment station, seem confirmatory of this view, and seem to suggest in addition that seeming sports are often the result of atavism.

Appended are a few of the variations which are to be found in the leaves of the dandelion, selected rather as representative than as exceptional. A series could readily have been selected showing a passage from one type to another, as frequently leaves of quite different appearance appear on the same plant.

Varieties of Dandelion leaves.

THE RELATIONS OF MIND AND MATTER.

BY CHARLES MORRIS.

(Continued from p. 1159, December number.)

MUCH space might here be given to the numerous and important observations on hypnotic phenomena published of late years, but we must confine ourselves to the mesmeric experiments of the Psychic Society. These experiments were very numerous, and were conducted with such extreme care that their evidence in favor of direct mental communication seems incontestable. Their results were of a more declared character than those of the thought transfer experiments. Not only thought transfer but mind control appeared. The active seemed to take full possession of the passive mind, and this often with a considerable distance intervening between the parties. The thoughts of the one mind appeared to infuse themselves into the other, driving back its own consciousness and replacing it with a pseudo-consciousness, and this so completely that the sensations of pain, taste, &c., felt by the operator, were also felt by the sensitive, and referred by him to their appropriate locality in his own body. In like manner the direct control of the mind of the sensitive over his body and of his body over his mind was exercised by the operator, and consciousness of pain in any part could be abolished at will. Some of these phenomena, indeed, were so curious and the mode of producing them so significant, that it certainly appeared as if the whole body was permeated by psychic substance, and that the mind was related to the outer world by psychic nerves in an equivalent sense to its material nerve connection.

In these mesmeric phenomena, however, it is evident that the channel of communication between mind and mind is not usually an open one, or the body psychically transparent. Most persons are more or less obtuse to the psychic sense, and only in special cases is it freely active. And in these cases the relations of operator and sensitive are personal. No second operator can exert an equal control over the sensitive. It is as if the psychic nerve, like the physical nerve, became susceptible to familiar influences, but resistant to unfamiliar ones.

Of the other phenomena adduced by this society it will suffice to refer to those of psychic communication at a distance, of which they give many seemingly well authenticated instances. In one

of these the thought transfer passed as far as from Burmah to England. In these latter instances there was, in nearly every case, an active mental excitation in the one mind in reference to the other. They are most usual at the moment of death, the mind of the dying person appearing to be affected with a strong emotional longing to communicate with the living. In many such cases a spectral reproduction of the dying person has appeared to the subject of his or her thoughts, apparently in real form, but doubtless as an image impressed directly on the mind. It may be that a sudden rousing of the recollection of any distant person, without its being led up to by a train of conscious thought, might, if the effect be a strong one, seem like an actual vision. An object seen is not led to by consciousness, and a mental image not led to by consciousness might easily have the force of an object seen, or of a temporary hallucination. In many of the numerous instances given, the person whose image was seen was in full life, yet in some perilous situation or other condition that would be likely to arouse sudden and intense emotion. And usually the recipient was the object of this emotion. There is no evidence to show that this relation did not exist in every instance, but simply that it was not always observed.

As to the distances to which these impressions were frequently conveyed, or the rapidity with which they passed from mind to mind, there is nothing surprising if the hypothesis we have given be accepted. We know the rapidity with which light travels through the ether, and the electric current through solid matter, affecting objects very far removed in very minute intervals of time. We know that the influence of gravitation is felt with no apparent lapse of time through vast distances. The least variation in distance and weight of one body is instantly felt by other bodies, though they may be very distant. If there be a psychic substance it is highly probable that the same relations may exist between its separate masses. The ether may convey its vibrations to vast distances, as it does those of matter, and produce similar effects on distant psychic masses. If this substance is transparent to the vibrations produced by matter, matter may be similarly transparent to its vibrations and no check to their outflow be felt. We know that an electric charge, when sent "to earth," spreads with immense rapidity throughout the substance of the earth. It weakens as it spreads, yet may be strong enough

at a considerable distance to act upon a sensitive electric instrument. The matter of the earth may be still more transparent to psychic radiations, and permit them to spread with the utmost freedom and rapidity. Such impulses might touch without effect a multitude of minds, and yet rouse one mind to consciousness if it met there with conditions in harmony with the conditions of the vibration. A thought is an active and peculiar motor energy. It carries with it, when emitted, the characteristics of its source. If it meets anywhere a psychic condition to which these characteristics are familiar, or with which they are harmonized, it might rouse a conscious response, or call up, more or less completely, the mental image of the emitting mind and person.

There are other phenomena which seem to indicate the existence of such a medium of psychic communication. And the indications are that emotion is necessary as a preliminary to distant and vigorous outflow of psychic energy, though not necessarily so in case of contiguity. In emotion the motor conditions of the mind seem strongly exercised, as are those of matter in case of high temperature, and in both cases there seems an energetic outflow of vibrations. It is well known that a congregation in a state of emotional excitement can be swayed by an emotional speaker in a manner that utterly ignores all exercise of reason or individual intellect. The power of all great orators over an audience has been largely of this emotional character, and audiences are frequently fully controlled by addresses which, read in a cool state, arouse surprise how they could have affected any person of sense. An instance of the same character is that of the sudden panic which has so often spread like wild fire through a whole army, sweeping away regiments that have not felt a bullet of the enemy. The intense mental excitement seems to flow out in vibratory waves, affecting all minds within its influence, and arousing everywhere a similar excitement without regard to difference of circumstances.

History is full of instances of the same general character. And we find in every instance that it is the ignorant, or the strongly emotional, who are swayed by these influences, while the educated, the cool and the reasoning minds resist them. Several instances from the history of middle age Europe may be adduced. We might describe the epidemics of migration, as in some of the Crusades, of witch-craft, sorcery, lycanthrophy, etc., that have

from time to time broken out, and raged in spite of every effort at suppression. But we have only space for some of the more particular instances. It is significant that the most remarkable of these emotional epidemics have followed terrible pestilences, famines, or other great national calamities. Thus the terrible "Black Death" pestilence of the fourteenth century, which threw all Europe into a condition of severe mental depression, and roused a host of superstitious fears, was followed by extraordinary outbreaks of fanaticism. These were the Flagellation mania and the Dancing epidemic. In the one, Europe was filled with throngs of self-flogging maniacs. In the other hosts of dancing and singing convulsionists everywhere appeared, seemingly possessed by a fury, and convulsively leaping until they sank down in utter exhaustion. The Tarantula epidemic of Italy was of the same general character.

Two cases related by Zimmerman may be here particularly given. In one case a nun, in a very large French convent, began to mew like a cat. Soon others of the nuns imitated her, and ere long the whole of the sisterhood were diligently mewing. So strongly did the mania possess them, that it was only broken up by the stationing of a company of soldiers near the convent, with a threat to whip any one who should indulge in the peculiar vocal exercise. Dread of the whip proved a stronger mental force than the desire to mew, and the convent returned to its former peace and quiet. In the other instance a nun in a German convent, of the fifteenth century, began to bite her companions. Soon all the nuns fell to biting one another. As the news of this spread to other convents the biting mania broke out there also, until it spread throughout Germany and Holland, and extended so far as Rome.

The emotional character of the mental operations of a religious sisterhood probably renders them specially susceptible to such psychic influences. In all such cases a considerable degree of mental excitement seems to have attended the mania. And it has been usually confined to the lower classes, though in a case of long continuance, like that of the Flagellants, nobles and ecclesiastics, with many other persons of honorable birth, became affected. In these days of science, education, and active thought generally, such extended manias have ceased to exist, though minor examples may yet be found in ignorant communities. In all

these instances there seems to be a general outflow of psychic energy of a peculiar kind, which acts to produce accordant states in all minds into which it flows, unless they are intellectually active enough to resist its influence. We all know how difficult it is, even in educated persons, to resist the psychic influence of a strongly emotional speaker, even though the reason may resist his arguments, and how resistance becomes lulled and conviction produced, by the pure force of "personal magnetism." And knowing this we cannot wonder at the remarkable influence of some very irrational revivalists.

The subject has here been very briefly and incompletely treated. Had we space to give in full the abundant evidence that might be offered, and to detail the strict test conditions under which it was often received, the fact of a direct intercourse of mind with mind, and control of one mind by another, without the intermedium of the senses, might be shown far more clearly. And the indications strongly point to some such conclusion as that here reached, that the mental powers are based in a special psychic substance, and that masses of this substance act upon each other through the ether in methods closely similar to those in which masses of matter act on each other.

One further question of great importance here comes into play. If psychic substance begins its existence as "bound ether," ether condensed by the attractive force of atoms and molecules, can it exist in this condensed form separate from the atoms and molecules? If these continue to exist must their ethereal atmospheres remain permanently bound to them? If they should in any way be destroyed, would the ethereal atmospheres resume their original condition of free ether? If we have dealt with pure hypothesis so far, it may be well to follow our hypothesis to its ultimate consequence.

That bound ether is an existing fact is becoming more and more generally admitted. Sir William Thomson, in a recent paper,[1] views it as a necessary condition to the phenomena of refraction. And if it exists it seems equally necessary that the ethereal atmosphere must be affected by the motions of its nucleus and assume accordant motions. If so, the destruction of the material nucleus might leave the condensed ether as a persistent atom or molecule, since it would possess the motor organ-

[1] Read before the Royal Society of Edinburgh, January, 1885.

ization of a material atom or molecule. On the other hand, while the atom or molecule of matter continues intact, it would seem as if its bound ether must remain confined to it and accompany it through all its integrations and disintegrations. Absolute accordance in motions and the persistent vigor of attraction must prevent any separation of the bound ether from its nucleus. Under these conditions, therefore, there could be no separate existence of a psychic substance.

But this is but one of the probable conditions of existence of this substance. Bound ether may be strongly influenced by other motor energies, which but feebly influence its material nucleus. In this respect the phenomena of the mind lead to some very interesting conclusions. If the physical basis of the mind be the bound ether of the cerebral cells and molecules, it must originally be intimately related in motion and condition to these cells and molecules, and can have no power of separate existence. But the whole process of development of the mind is one that tends to break up this intimate connection. The psychic substance of the cerebrum is affected, not only by the normal cerebral motions, but by innumerable motor conditions coming from external substances, through the medium of the nervous system. These conditions but slightly and temporarily, so far as we can judge, affect the sluggish matter of the cerebrum, but strongly and permanently the mobile substance of the mind. The mental substratum thus becomes affected by motor conditions which have no fixed counterpart in the brain substance. The original close motor accordance is broken; and with it the effect of molecular attraction is weakened. Such a result would be precisely parallel to that common in chemical action, in which motor inharmony seems a steady opponent of the force of affinity. Affinity is most vigorous when motor harmony exists. If the motor inharmony becomes great, molecular separation takes place. A similar rule may well hold good between the cerebral molecules and their bound ether. As the absorption of external energies by the bound ether produces motor inharmony, the effect of the attraction is steadily weakened. The bound ether is converted into specially organized psychic substance. In such a case there might be a fresh condensation of ether around the molecules, and this, in its turn, would become the recipient of new inflowing energies. In this way a continually increasing

volume of psychic substance might be formed by the addition of new surface films, each becoming specially organized by sensory influences, and losing its intimate relation to cerebral matter.

In such a method the bound ether of material molecules may be converted into the psychic substance of mind. And with every transfer of energy from matter to psychic substance, consciousness may declare itself. The conditions of mental development and mental reception of sensations, as considered in the preceding section, are in close accordance with this idea. We have not matter with two sides, or with duplicate physical and mental motor relations, as considered by Mr. Bain in his Mind and Body, but two distinct conditions of substance, originally intimately bound together, but becoming separate as their motor conditions become inharmonious. In such a case the disintegration of the brain would not carry with it the disintegration of the mental substratum. The latter has ceased to be the bound ether of the former, and the cerebral molecules could only carry with them their latest increment of bound ether without affecting that which had escaped from this condition. Nor could the energies which cause the disintegration of the brain produce the same effect upon the psychic substance. A substance through which the most vigorous motor energies, such as those of light and heat, pass without producing any permanent disturbance of its conditions, might remain utterly unaffected by the most intense disrupting energy of material agencies, and survive the body as a concrete organism.

In fact the close connection between brain and mind seems to depend in some measure upon the activity of the brain. This activity appears to enhance the attractive hold of the cerebral cells upon their psychic outgrowth. It is during the stage of cerebral activity that external sensations are most abundantly and intensely received. With the partial cessation of this activity which takes place during sleep, some degree of weakening of the bonds between mind and body seems to take place. During deep sickness, or at the near approach of death, the bond seems to become still weaker, and the mind, with no impairment of its activity, seems often to be partially independent of the inactive body. The complete cessation of cerebral activity, which comes with death, may utterly break the bond of connection, the molecules of the brain only retaining their latest increment of bound

ether, while the organized psychic cerebrum becomes a free organism. Whether with it is freed a closely related psychic organism, the outcome of the whole body development, and reproducing every detail of the body, is a question of secondary concern. It is sufficient for our present purpose to show the conceivable separate existence of a psychic cerebrum, possessing the definite organization of the material cerebrum, and in addition all the thought conditions of the developed mind.

If the human body, as the highest outcome of its organization of energy in matter, is capable of producing such a self-centered and self-existent psychic organism, a like power, though in a lower degree, must exist in lower organic beings, and possibly in inorganic compounds. Every concrete mass which received external energies, without being molded by them, might have its bound ether molded by these energies and thus converted into psychic substance, capable of self existence when definitely separated from its nucleus. All matter may thus act as a laboratory for the elimination of psychic substance from bound ether. The freed mental organism might find an accordant sphere of existence thus prepared for it, and as thoroughly adapted to its powers and needs as the material earth is to ours. Nor could we become sensible of the existence of substance in this condition, its complete transparency to radiations of light and heat rendering it imperceptible to our senses and our instruments. Such may be offered as a speculative conception of the possibility of the existence of the mind after the dissolution of the body, in a sphere of substance suitable to its needs and powers. It is a conception towards which many partial steps have been made, but this may be offered as the first definite hypothesis of the development and conditions of the mind, based upon the conclusions of modern science.

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SOME NOTES ON THE LIFE-HISTORY OF THE COMMON NEWT.

BY COL. NICOLAS PIKE.

THIS little reptile, our common newt or spotted eft, *Diemyctylus miniatus viridescens* (Raf.) Cope, is numerous on Long Island from Brooklyn to Greenport, and is equally well known all over the Eastern States. It may be caught from March to December, as it bears a very low temperature, and I once saw it

swimming under the ice in a pond near Fort Hamilton. It is gregarious, bears confinement well, and I have often kept it for over a year in my aquarium.

Its food is very varied; it will take aquatic and other insects, small tadpoles, worms, especially earthworms, and it will eat small pieces of raw beef and fish when hungry. Though a harmless little reptile, it will quarrel occasionally with its companions about food. I have seen one seize a worm twice its own length and try to gulp it down holding it with the hands; a second would snatch up the other end and begin swallowing it till the two met. Then such a pulling and wriggling ensued, till the strongest or most persistent succeeded in making the other disgorge its meal. Sometimes it would take nearly a day before the worm vanished, the first part having to be digested before the last could be swallowed. In confinement they should have only the smallest worms, as the large ones disagree with them, and I have often had them die after one of these gorging meals. They are very fond of the small fresh-water bivalves so abundant in most of the ponds they frequent. Many are swallowed whole; one I dissected had four —shells and all—in its stomach.

When caught the little harmless creatures do not try to escape but hang limp in the fingers.[1] They are, however, as cunning as all the rest of their race. I placed one on my table to examine it, when it crawled under a sheet of paper and crouched down as if asleep. I was called away for a few minutes, and on my return found my little friend had absconded. Now it had not attempted to move for over an hour in my presence, but was evidently at once conscious of my absence. It was sometime before I found it on the opposite side of the room, it was so nearly the color of the carpet. It never does to trust to the apparent helplessness of any animal, for what it lacks in outward means of defense it is sure to make up in cunning.

I accidentally found out one of this animal's most deadly enemies. I once brought home a lot of the *viridescens* in a box of leaves in which I had thrown some wire-worms, thinking they might serve as food, they were so abundant around the pond. The next morning I found my poor little prisoners had all been

[1] Sometimes they emit a faint cry, but this is generally in the breeding season. It is a faint squealing sound not unlike that made by the *Spelerpes ruber*, but not so loud, and is I believe only heard from the males.

attacked by the wire-worms, pieces of flesh being eaten out of their living bodies. One had coiled so tightly round its victim it was paralyzed and died directly I removed it. Though so abundant, yet large numbers when young are devoured by the strong larvæ of the *Amblystoma punctatum;* the robust frog tadpoles also mercilessly nip off their gills and tails, and they soon die. These facts I have often witnessed in my aquarium.

Everyone knows these pretty olive-backed newts, yellow underneath, the whole body and tail spotted black, and on the sides a row of flame-colored spots encircled black, but everyone does not know, and perhaps never saw the change that takes place on the approach of spring, when the males assume their brightest dress preparatory to courtship. Over the back and tail waves a graceful spotted crest, the color underneath changes to orange, and the inner side of the legs is deeply barred jet black—all of which last during the breeding season and then the crest is absorbed, the black bars and bright color fade out till the next love time of the year calls them forth.

I believe this animal is incapable of reproduction under four years of age, for its growth is very slow even in its natural state. When the love-making commences there is a busy time amongst the denizens of the ponds. The males dart about, gyrating round their chosen mates, heading them off in their endeavors to escape, and when they have at last won the victory they seize the females round the lumbar region and remain thus often for hours. The milt and ova pass simultaneously, and the operation takes some time, but it is generally accomplished under cover of darkness. The older females often deposit 150 to 300 eggs at a time, which they attach to twigs in the water or long grass. The eggs are very small at first but rapidly swell. Younger females only lay from twenty to fifty eggs in a small group.

I am not aware of any one having published any account of the hatching of the eggs of *D. viridescens* except Professor A. E. Verrill, who, in the AMER. NATURALIST for 1870, wrote as follows: "The eggs of the common water newt were observed by Mr. S. J. Smith and myself at Norway, Maine, in '63 and '64, attached in round masses, two or three inches in diameter, resembling frogs' eggs, on stems of water plants in ditches in a meadow. The eggs were found May 5th, and reared by Mr. Smith, hatched May 17th, and by October 1st were one and a half inches long. They

had stout bodies and broad heads, and still retained their external gills, though they had partially acquired the colors of the adult. The experiment was then discontinued but the specimens all preserved."

This only came under my notice in October, '84, when I was delighted to find Professor Verrill's statement verified my own experience, which I will now relate:

On the 6th April, '84, a quiet cool morning, whilst sweeping my net in a pond at Jamaica ridge, I detached some bunches of ova from several dead branches that lay in the water. They varied in size from two and a half to six inches in diameter, containing from 25 to 150 eggs each, all enclosed in a glairy mass. The eggs were brown above, pale beneath, each in a greenish double envelope, but so transparent that the development was distinctly visible.

This is a most perfect arrangement for the protection of the ova; a space lies between the envelopes and each can be separated in its own globe of glaire from the rest. These coverings are tough and not easily injured, and so firmly attached to the branch I had difficulty in loosening the whole without breaking it up. It would take a very strong wind or current to dislodge these carefully protected embryos.

They were all deposited on the south side of the pond where the sun shone in between the trees, about six or eight inches below the surface, in very clear water. I brought them home in a pail of water and placed them in an aquarium. I prepared for them with aquatic plants and débris from the pond. I thought I had secured the spawn of the *A. punctatum*, not thinking of Diemyctylus, which is mostly accredited with depositing one or two eggs separately in a folded leaf. From the appearance of the ova some must have been laid the preceding night, while others showed a curious mass of small granulations.

In a few days a sort of break up of some of the ova took place, if I may so express it. The embryo assumed a fish-like appearance with a blunt head, curled up tail and a thick solid body. During the next fourteen days the brown body enlarged, head was very dark, outline of eyes visible, snout broad and thick and if shaken the little creature displayed considerable irritation by a twitching of the tail. By the 20th the body was elongated and curved, the flattened tail showing a fin, the verte-

bral striæ and branchiæ with the minute claspers all were visible with a good glass. The glairy coverings enlarged with the creature's needs, and by the 28th some had emerged and commenced life on their own account. On the 9th May the film disappeared from the eyes, the gills were free, and what seemed to be thin white threads were really the first appearance of the anterior legs, but only by the aid of a powerful glass could the two little claw-like fingers be seen. A dark stripe showed from nostril to eyes and another on the head, and the whole body was covered with fine dottings.

It is very difficult to know what is the food of these mites, at this stage only half an inch long. It can only be the minute monads and confervacious spores in the water. The glairy envelopes remained long without decomposition, intact but for the cleft by which its occupant emerged. I am half inclined to think the young still feed on them, for they hang round them constantly; I know frog and toad tadpoles will feed greedily on these empty shells.

The little newts would remain motionless for a long time as if dead, but if disturbed would rush madly round. The whole of the ova did not hatch till the middle of May, so the first out must have been laid in March. By the 15th there was little doubt in my mind that I had at last solved the problem of the spawning of the Diemyctylus. The reddish gills were well fringed, the eyes prominent, the front legs transparent and white fingers free, the abdomen shewing the viscera, and the body dotted all over. A dark stripe from snout to eyes is, I find, never absent in the larva of this species.

On the 25th I procured a quantity of Lemna or duckweed for my aquarium, and it spread all over the surface of the water. My little pets delighted in it, and when the sun shone they would crowd under it in every position, seeming to hang on to the slender roots.[1] They certainly throve in their leafy home, and flourished so well that in a month, on the 25th of June, they were an inch long, very active, brownish-gray in color, with a series of whitish markings where the spots were to appear later. The abdomen alone was spotless. Two fingers and two knobs showed in front, and the hind legs were out but the feet only slightly

[1] Possibly the Lemna contained minute spores, or ova of insects, which served them as fresh food.

developed. The young begin to molt in confinement about the second month; later on, with every change, the spots which are only blurred white markings at first, assume a more definite shape. The adults change their skin frequently when they have abundant food, which has the same effect on the Urodela as on the ophidians.

Thus far all went well, but then began the great trouble always experienced at this stage in rearing the Urodela, much greater than that of the Anura. The latter will feed greedily on decomposed animal matter that the former seem to care little for, in confinement at least. I tried every kind of aquatic plant and small insect I could get from the ponds, but uselessly, many died and the rest were thin as shadows but active as ever. A few survived till August and well proved their identity, when I put the last but one in *spirits to save its life!* The last I kept alive till nearly the end of the month by feeding it on little red mites that swarm in the ponds at that season, but even it succumbed, and it was still only one inch long when it followed its mates, never having grown since June. I preserved a series of specimens from the spawn upwards, and I hunted the ponds so persistently that I was able to supplement my own deficiencies by larvæ from them in every stage, so that now it is complete in my cabinet from spawn to a fine adult five inches long.

To show the difference in rearing these animals in confinement and in their natural state, I will mention that on June 14th I took some larvæ from the same pond over two inches in length and quite fat. Doubtless the great increase of size over mine was due to abundance of suitable food, fresh air and abundant room to swim about in. I have had ample proof that the breeding season extends even to May, from the very small larvæ I have taken even in July.

Some young taken in September were a dark olive, the tail nearly black and feet dark; those of October showed a little dotting on the chin; those of November had the gills absorbed, were about two and a half inches long, and were sparsely dotted underneath, but the side spots still white. I do not think the flame color always comes in till the second year, and the buff color of the abdomen shews about the same time. As the animal nears the period when the gills completely disappear, its body diminishes in size, and I have taken some in the second

year on land barely two inches, tail included. The atrophy of the branchiæ begins at the extremities and goes on very gradually till the fimbriæ are absorbed, when the rest roll up and leave two rounded tubercles that I have still found in specimens taken in December just before hibernation.[1] As the gills are absorbed the form of the head changes. During their growth it widens considerably in front of them, but on absorption the neck becomes narrow, and between the eyes it is broader. The fin, round back and tail vanishes at the same time.

Both sexes leave the water after the mating is over for a time, and hide, without feeding, under stones and tussocks. The young of the second year sometimes leave the water for months together and secrete themselves in damp places. When droughts occur and the ponds dry up I have often dug them out, all huddled together, more than a foot below the surface, and where the clayey ground has become so parched that they are unable to burrow they are often seen several together, dead and dried up.

This season, 1884, an exceptionally mild one, I took, on a bright warm day early in December, quite a number of large *viridescens*, both male and female, very active although there was a thin coating of ice on the pond. The former had the legs already barred and the tails finned, while the latter were large and fat. I dissected a female and found her full of good-sized ova.

Diemyctylus mineatus (Raf.) Cope (Eastern water newt).—This little animal, formerly supposed to be distinct from the last described, and mentioned in the latest bulletin of the Smithsonian Institution, is now generally acknowledged to be only a color variety of the *D. viridescens*. Dr. Hallowell was the first to express his belief that the so-called distinct species were the same. Professor Cope[2] says, "the nominal *D. miniatus* is a state of *D. viridescens*," and that he has had it change to the latter in confinement.

Mr. Howard A. Kelly, in an article in the AM. NATURALIST, states, "he brought home a number of *D. miniatus* (Raf.) or little red lizard or red eft, and after keeping them in a dark box filled

[1] These animals do not, I believe, really hibernate in the usual acceptation of the term, that is, they do not often become dormant. In January and February, when the ponds are frozen over, they resort to the deep holes, where they remain huddled together, if not disturbed, till the genial sunshine again calls them forth to activity.

[2] Professor Cope has studied the Urodela perhaps as much and as carefully as any one in this country, and is therefore an undoubted authority on the subject.

with saturated moss, they changed their color from a bright vermilion to the olive state characteristic of the *D. viridescens*," and he kept them all winter.

I have gradually come to the conclusion that the two are identical. Some years ago I captured quite a number of red ones in the Catskill mountains, brought them home and kept them in a box with other salamanders, where they could resort to water if they chose. For some days they remained hiding under the wet moss and stones, but finally crept out at night and went into the water. I gave them insects and worms, which they readily devoured. In about three months they lost their bright red, and in less than a year they were of the usual olive of the *viridescens.*

Another fact still more decidedly bearing on the case, is, that some two year old olive-colored *viridescens* taken from the ponds and put in earth and dead, wet leaves in a tub in my garden without water, in a month or so began to lose their green tint and assume a dingy brownish hue.

It is well known that the Diemyctylus often stays away from water for months at a time, but roams round at night in the damp earth and grass in wet weather.

The food these animals take plays also a very important part in their coloration and growth, just as we see in the whole animal kingdom. In the ponds the *viridescens* is generally a dull olive, almost the color of the green slime and plants covering them, in which they hide almost unseen. On land, where they are always in the day time, either under stones or dead wood or in the earth they have burrowed in, they assume more the color of these objects to hide from whatever enemies they may have in their new habitat.

Then as to food; in the water they have abundance of succulent nutriment — mollusks, tadpoles, ova of reptiles and fish, aquatic insects and plenty of confervaceous plants on which they and their prey alike feed, and which doubtless assists in their coloration. Now as soon as they leave the water their food changes at once to spiders, insects, earthworms, &c., so totally different from the prey of the ponds, and it is most probable this is the first cause in the change of color in the little Diemyctylus.

Locality has also considerable to do with the tints of the skin in these animals, as we see so prominently in snakes, especially

in the genus Eutænia, where difference of locality has had such an effect on the coloration as to give rise to several species being made out of the common garter snake.

I have procured these newts from many places in New York and New Jersey States and different parts of Long Island, of every shade of red up to very bright scarlet, yet within a radius of many miles from Brooklyn, where the *viridescens* and its variety are both plentiful, I never find the latter other than a reddish-brown, varying from light to very dark. Sometimes late in December I find little brown ones with flame-colored spots, in the ponds. These are so greatly attenuated it is possible they have returned to the water in search of food, lacking on land, at so late a period when all animal life which would be available for them disappears from the surface.

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THE RELATION OF THE PECTORAL MUSCLES OF BIRDS TO THE POWER OF FLIGHT.

BY CHARLES L. EDWARDS.

OF all the modes of animal locomotion flight is the most rapid, the most graceful, the most fascinating. With one important exception this power separates the bird from the other vertebrates and gives it preëminence in motion. Its whole structure—the conical form of the body offering so little resistance to the air, the hollow bones, the air-sacs and the weaving together of the smallest barbules to form the close web of the wing—all denote that in the air, in flight, is the bird's life.

While in a very general way much has been observed with regard to the variation in the power of flight of species differing quite widely from each other, yet there are still some unsolved problems connected with the highest form of motion.

Before attempting the solution of any special problem there are certain mechanical elements of flight with which we must become familiar.

A body much heavier than air is to be propelled with great speed through the air. The resistances are the force of gravity and the air itself.

The perpendicular action of the broadly expanded wings opposes as much as possible the force of gravity, while the narrow

wing-line and the cleaving form of the conical body reduce as much as possible the resistance of the air in front.

The cause of motion is the action of the wings upon the highly elastic air producing by reaction forward movement of the body. The source of this action is in the pectoral muscles. Its instruments are the wings. Wonderfully indeed are the wings adapted to their purpose. Of extreme lightness and of great rigidity and strength, their weight is but a slight hindrance and their leverage a vast advantage in producing motion.

Concave beneath and convex above, with underlapping feathers, to the one side is presented a grasping surface almost impervious to air, and to the other a lattice-work structure through which air easily rushes. So in the depression of the wing all possible advantage is gained from the elastic resistance of the air, and in its elevation the least amount of force is lost.

The muscles which furnish the propelling force to the wings are those of the breast, the pectoralis major and the pectoralis minor. The pectoralis major is a large, triangular muscle forming the principal part of the bulk of the breast. It arises from the ribs, from the outer portion of the ventral surface of the sternum, from the side of the keel of the sternum, from the furculum and the membrane connecting the furculum with the sternum and the coracoid. The fibers converge, the outer turning under the inner and inserted by a tendon on the greater tuberosity of the humerus. In action this muscle depresses the wing and thus furnishes the great motive power of flight.

The pectoralis minor is much smaller than the preceding, and beneath it; arising from the middle portion of the sternum and the membrane attaching the furculum to the sternum and the coracoid. Its fibers converging terminate in a tendon which, after passing through the end of the coracoid, is inserted on the inner side of the greater tuberosity of the humerus. This muscle, together with the resisting force of the air, elevates the wing after it has been depressed.

From the structure of the wing it is apparent that the work of this muscle is relatively small except, perhaps, in "sailing," as seen in the flight of swallows, where the wings must be held tense and at a constant angle by this muscle. It would clearly appear, when we consider the law of muscular development, that in those species which fly most of these muscles would be rela-

tively larger than in those of less power of flight. Conversely, other things being constant, those birds in which the pectoral muscles form a larger percentage of the weight of the body, would have a greater power of flight.

This being true the question naturally rises: What is the variation in the development of the pectoral muscles for the different species of birds, and is this variation by natural families or by individual species?

In the solution of our problem the shape of the wing plays an important part. The long, narrow, sharp-pointed wing is most advantageous to continued flight, and the shorter, rounded, less-compact form is least so. Between these two extremes there is an indefinite shading of the one form into the other, with more or less resulting advantage as the case may be.

The pectoral muscles may be relatively large, yet if the wing be of impeding form, so that considerable force is lost in overcoming the consequent disadvantage, the resulting power of flight is much lessened.

In this paper I have taken the weight of the whole body as a constant basis and found the percentage by weight of the pectoral muscles in the body. The data are derived from the dissection of 119 birds, having in all cases possible taken an average for each species from three individuals.

There are represented seven orders, twenty-five families and fifty-three species. It will be seen that variation is not by natural families but by individual species. This is explained by the fact that though certain species may have structures so allied as to join them together in a family, yet because of their distinct habits of life they may differ considerably in their power of flight.

List of species examined, arranged in order of percentage of pectoral muscles to total weight of body:

Broad-winged hawk.....5.98 per cent. *Buteo pennsylvanicus.*		Maryland yellow-throat....7.50 per cent. *Geothlypis trichas.*	
Screech owl.....6.14 " *Scops asio.*		Blue-jay.....7.68 " *Cyanocitta cristata.*	
Mallard duck.....6.68 " *Anas boschas.*		Song sparrow.....7.84 " *Melospiza fasciata.*	
House wren.....6.87 " *Troglodytes ædon.*		Mud hen or coot.....7.89 " *Fulica americana.*	
Cat-bird.....7.12 " *Mimus carolinensis.*		Brown thrush.....8.00 " *Harporhynchus rufus.*	

Loggerhead shrike.....8.04 per cent.
Lanius ludovicianus excubitorides.

Red-headed woodpecker...8.21 per cent.
Melanerpes erythrocephalus.

White-throated sparrow....8.31 "
Zonotrichia albicollis.

Chewinck.....8.60 "
Pipilo erythrophthalmus.

Olive-backed thrush.....8.73 "
Hylocichla ustulata swainsoni.

Cliff swallow.....8.74 "
Petrochelidon lunifrons.

Summer warbler.....8.76 "
Dendræca æstiva.

White-bellied nuthatch.....9.03 "
Sitta carolinensis.

Purple martin.....9.19 "
Progne subis.

Ruddy duck.....9.33 "
Erismatura rubida.

Orchard oriole.....9.42 "
Icterus spurius.

Baltimore oriole.....9.51 "
Icterus galbula.

Blue-winged teal.....9.58 "
Querquedula discors.

Rose-breasted grosbeak.....9.66 "
Habia ludoviciana.

Titmouse.....9.78 "
Parus atricapillus.

Fox sparrow.....9.87 "
Passerella iliaca.

Snow-bird.....9.97 "
Junco hyemalis.

Crow blackbird.....9.99 "
Quiscalus versicolor.

Belted kingfisher.....10.03 "
Ceryle alcyon.

Tree sparrow.....10.03 "
Spizella monticola.

Blue-bird.....10.05 "
Sialia sialis.

Gold'n-wing'd w'dpecker10.09 per cent.
Colaptes auratus.

Wild goose.....10.22 "
Branta canadensis.

Meadow lark.....10.34 "
Sturnella magna.

Red-eyed vireo.....10.40 "
Vireosylvia olivacea.

Field sparrow.....10.55 "
Spizella pusilla.

Scarlet tanager.....10.65 "
Pyranga rubra.

Chimney swift.....10.75 "
Chætura pelagica.

Pigeon.....11.09 "
Ectopistes migratorius.

Chipping sparrow.....11.14 "
Spizella socialis.

Black-throated bunting..11.23 "
Euspiza americana.

Robin.....11.41 "
Turdus migratorius.

American goldfinch.....11.43 "
Astragalinus tristis.

Cow-bird.....11.50 "
Molothrus ater.

King-bird.....11.61 "
Tyrannus carolinensis.

Wood duck.....11.91 "
Aix sponsa.

Wood pewee.....12.10 "
Contopus virens.

Green-winged teal.....12.14 "
Nettion carolinense.

Shore lark.....13.32 "
Otocoris alpestris.

Quail.....14.99 "
Ortyx virginianus.

Ruffed grouse.....15.51 "
Bonasa umbellus.

Mourning dove.....16.33 "
Zenædura carolinensis.

From the following comparisons of the hen and the goose with the nearest allied wild species which I have been enabled to ob-

tain, the results of domestication as affecting pectoral development is readily seen:

Ruffed grouse (*Bonasa umbellus*)	15.51	per cent.
Hen	4.66	"
Wild goose (*Branta canadensis*)	10.22	"
Tame goose	6.40	"

I do not claim that from this list the exact place of a bird can be given as to its power of flight, because other elements than the size of the pectoral muscles enter into this complex problem so as to preclude an absolute classification on the basis of pectoral development, yet I think that there is a relative variation expressed by the figures given in this list, and that when together with this element the other elements of flight are considered we can tell the place a bird should occupy in the scale of flight.

——:o:——

GEOLOGICAL EXTINCTION AND SOME OF ITS APPARENT CAUSES.

BY A. S. PACKARD.

IN his Origin of Species, Darwin says: "The extinction of species has been involved in the most gratuitous mystery. Some authors have even supposed that, as the individual has a definite length of life, so have species a definite duration. No one can have marveled more than I have done at the extinction of species." Finally, he remarks, "Thus, as it seems to me, the manner in which single species and whole groups of species become extinct accords wells with the theory of natural selection. We need not marvel at extinction; if we must marvel, let it be at our own presumption in imagining for a moment that we understand the many complex contingencies, on which the existence of each species depends. If we forget, for an instant, that each species tends to increase inordinately, and that some check is always in action, yet seldom perceived by us, the whole economy of nature will be utterly obscured. Whenever we can precisely say why this species is more abundant in individuals than that; why this species and not another can be naturalized in a given country; then, and not till then, we may justly feel surprised why we cannot account for the extinction of any particular species or any group of species."

The fact of extinction is indeed not less marvelous than that

of evolution, and one cannot in these days feel satisfied that the solution of the problem lies in the theory of natural selection, which accounts for the preservation of species rather than their origin or extinction. Mr. Darwin having been the means of bringing many naturalists to believe in the theory of descent, they are not to lie supinely on their backs, resting securely on the dogma of natural selection and cease from all attempts to investigate the cause of evolution, to cease building a foundation for the working of natural selection. On the contrary the search for the causes of the transformation of species will be carried on with more energy, thoroughness and success. The clews which we already have discovered will be followed up, and finally we shall, by means of observation in the field and experiment in the laboratory, wrest from nature the secrets of life and its origin, and of the phenomena of death and extinction, not only of species but of orders.

Extinction may be both slow and rapid, the causes of each being primarily dependent on slow or rapid changes in the environment. The object of this article is to endeavor to show that the extinction of species is intimately connected with geological changes. It is a meagre sketch or outline of the more salient facts and laws which appear to us to immediately bear upon this intricate and difficult subject.

In Palæozoic times the climate of the globe was far more uniform than now. The continents of the present day were then of much less extent, in fact archipelagoes rather than continents; the land-surfaces were of moderate height, and mountain ranges smaller and lower. While the land masses or embryo continents of the eastern and western hemispheres were more or less independent centers of evolutionary creation, there was on the whole a great uniformity of plant and animal life. Species were perhaps more cosmopolitan than now.

When at the end of the Coal period the process of continent-making and mountain-building became greatly accelerated, resulting in that stupendous crisis in American geological history, the upheaval of the Appalachian mountain system, there must have been some degree of differentiation or setting aside of portions of the then continent into distinct areas or basins bounded by mountains, inland seas and rivers, and some slight subdivision into local faunas. We know that there was a distinct coal basin, or

series of them, for example in Arctic America, another in Northeastern United States, and in the Central States of the Upper Mississippi valley.

Other crises, extending over comparatively brief periods of geological time, however long when measured by centuries, were the elevation of the Rocky mountains, of the Wasatch, the Uintah ranges, the Sierra Nevada and Cascade ranges; and, meanwhile, the union of the Atlantic moiety and the Pacific moiety of our continent into a continuous land-mass. These periods of activity, signalized by extensive volcanic outpourings and great changes in the relative distribution of land and sea, must have been, as palæontology shows, periods of rapid extinction as well as of reparation or recreation. Progress in continent-making was accompanied by progress and an onward sweep in the tide of life, not only in animals with jointed bodies and limbs, but more especially in those with back bones and brains to correspond with their vertebrate rank.

Until the end of the Tertiary period the earth's climate was still nearly uniform. There was through the Miocene a general, indeed most remarkable resemblance between the flora of Europe and the United States, with that of Greenland and Spitzbergen, or the regions now lying in the frigid zone; this flora being in some respects like that of Louisiana.

It was not until the Glacial epoch that the earth's climate became differentiated into tropical and frigid and temperate zones. That great geological crisis, whether due to astronomical or geological causes, or both combined, by which over enormous tracts of land in Northern and Central Europe, and Northeastern America a frigid climate, with continental glaciers, was spread—that crisis produced results on the life of the glaciated region which we can easily appreciate. The extinction of life over the stated areas became widespread. The incoming of the Ice age also must have induced extensive migrations to the southward. As the glaciers melted, and the climate ameliorated, fresh migrations from the south set in, and thus in the early Quaternary period, when species were exterminated on a vast scale by causes readily appreciable, we have set before us, in a language which every one can translate, some of the geological causes of extinction, modification and consequent evolution of new forms.

We will begin, then, with a reference to the changes in the life

of the northern and southern hemispheres due to the glacial period. They are so familiar to the general reader that they need not detain us long.

By the end of the Tertiary period the northern regions, including the land around the north pole, viz: Spitzbergen, Novaya-Zemlya, Siberia, Greenland, together with Northern Europe and Northeastern America, must have abounded in life. Forests of trees, deciduous, evergreen and palmaceous, in their general appearance resembling those of Louisiana, spread like a mantle over the land, bordering the vast Tertiary lakes and sheltering herds of herbivorous mammals, such as deer, oxen, mammoths, which were attended by packs of dogs, or by solitary secretive cats prowling through the forest glades, waging war on the weak and defenceless or scattered ruminants.

This rich assemblage of mammalian life, with countless species of insects, and other invertebrate organisms, land, fresh-water and marine, was swept away. A large proportion died outright, perhaps a larger proportion migrated southward; a very small per centage survived. The mammoth and mastodon lived on, adapted themselves to the great change of climate, but just as the ice had passed away and the climate had ameliorated, and when the condition of life seemed more favorable, they succumbed. The Arctic bear, fox, lemming and hare, with the white ptarmigan and snowy owl, by adaptation to a snow-clad land survived, so to speak, the change, or rather, they are the descendants of species so plastic that they became modified, and adapted to an Arctic life. Even man, who appeared in the old world before or about the time of the incoming of the ice, not only followed the retreat of the glaciers, but adopted a strange sort of existence in a region where the climate has a mean annual temperature of less than 32° F. Wherever the Eskimo lived he found the walrus and seal, the modified relatives of the sea lions and sea elephants of other parts of the world. The profusion of Tertiary insect life was succeeded by a scanty assemblage of Arctic butterflies, moths, bees and other stragglers from the temperate regions.

The forests died outright, and where Sequoia, the sweet gum, the palm and other luxuriant semi-tropical trees flourished, now grow the dwarfed birch, willows and low herbs of Alpine and Arctic barrens. It is sufficiently manifest that the circumpolar flora and fauna are the dwarfed, or otherwise modified descend-

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ants of the Pliocene-Tertiary life of the same regions. Again, peculiarities in the distribution of plants and animals in North America and Northern Eurasia indicate strongly that there was an extensive migration southward down the Atlantic and Pacific borders of the continents as the glacial cold crept over the once populous circumpolar regions.

A second series of causes of extinction arose from the elevation or depression of extensive regions of the earth. The paroxysmal, elevatory process in the formation of the Cordillera of North, and particularly South America, involved corresponding more or less rapid changes in the flora and fauna of the Pacific Coast regions of those continents. In South America, particularly, during the Quaternary period, though there was no glacial period north of Patagonia, the extinction of life was widespread and marked.

As observed by Darwin and Alexander Agassiz, within historic periods there have been paroxysmal upheavals over thousands of square miles, if not over the whole extent of the Western Andean plateau.

For example, in 1822, after an earthquake, the coast line of Patagonia and Chili was suddenly elevated from two to seven feet above the level of the ocean. In 1835 Darwin, while at Valdivia on the coast of Chili, experienced the earthquake which devastated Conception, and he says his "compassion for the inhabitants was almost instantly banished, by the surprise in seeing a state of things produced in a moment of time, which one was accustomed to attribute to a succession of ages. In a single day, Feb. 20th, this earthquake shook the coast of South America over an area of 600,000 square miles, and the whole coast line of Chili and Patagonia was elevated from two to ten feet above the sea level." Darwin in his Voyage of a Naturalist remarks: "At the island of S. Maria (about thirty miles distant), the elevation was greater; on one part, Captain Fitz Roy found beds of putrid mussel-shells *still adhering to the rocks*, ten feet above high-water mark; the inhabitants had formerly dived at low-water spring-tides for these shells. The elevation of this province is particularly interesting from its having been the theatre of several other violent earthquakes, and from the vast numbers of sea-shells scattered over the land, up to a height of certainly 600 and, I believe, of 1000 feet. At Valparaiso, as I have remarked, similar shells are found at the

height of 1300 feet; it is hardly possible to doubt that this great elevation has been effected by successive small uprisings, such as that which accompanied or caused the earthquake of this year, and likewise by an insensibly slow rise, which is certainly in progress on some parts of this coast." Darwin adds: "Two years and three-quarters afterwards, Valdivia and Chiloe were again shaken, more violently than on the 20th [Feb. 20, 1835], and an island in the Chonos archipelago was permanently elevated more than eight feet."

As observed by Mr. A. Agassiz, there are sea corals of species still living in the Pacific ocean adjacent, attached to the surface of interstices in the rocks at Tilibiche, Peru, at a point about 2900 feet above the level of the sea. This locality is situated on a ridge parallel to the coast, there being a pampa or basin between this ridge and the coast range. This basin was probably the bottom of an internal sea which afterwards became a salt lake, and was eventually drained into the Pacific by the breaking through of the mountain barriers. The extensive saline basins on the western slope of the Andes, at an elevation of over 7000 feet, may have been former ocean bottoms. In his Andes and the Amazon, Orton says: "President Loomis of Lewisburg University, Pa., informs the writer that in 1853, after nearly a day's ride from Iquique, he came to a former sea-beach. It furnished abundant specimens of Patellæ and other shells, still perfect, and identical with others that I had that morning obtained at Iquique with the living animal inhabiting them. This beach is elevated 2500 feet above the Pacific." (p. 116.) Also, the presence of a species of Amphipod Crustacean belonging to "a truly marine family," dredged by M. Agassiz in Lake Titicaca at a depth of sixty-six fathoms, indicates that this lake may be a remnant of the Pacific ocean; though it now stands at an elevation of 12,500 feet above the sea.

These facts tend to prove that the Andean plateau during the Quaternary period was paroxysmally elevated into the air some 12,000 feet. Let us now look at the possible results of such an enormous upheaval on the plants and animals of this region. Before and at the time this movement began, when the land was 12,000 feet lower than now, the Atlantic trade winds which now cross Brazil, impinge upon the Andes and drop their moisture on the eastern slopes alone, then favored as well the western slopes

and Pacific coast. The tropical flora and fauna now confined to the neighborhood of Guyaquil on the coast of Peru then probably spread over Bolivia, Ecuador, Peru and Chili to Patagonia. The tropical belt in Peru ends with the chinchona forests of Loja, which is 6768 feet above the Pacific ocean. The sugar cane grows in Baños which is about 6500 feet high. At Riobamba, with an elevation of 9200 feet, the climate and vegetation are temperate; here occur bones of the mastodon, horse, deer and llama—animals which may have lived in a temperate climate. But was not their extinction, and that of the colossal sloths, armadillos, and other animals of the pampas largely due to a change of climate resulting from the elevation of the Andean plateau?

As the land gradually rose, the atmosphere would become more rarified and insupportable to tropical life; the animals and plants would either seek lower levels or undergo extinction, or in certain cases become modified into species suited to a temperate climate. As the plateau rose still higher, the air would become too cold and rarified for even the mastodon and horse. Gradually an alpine zone became established, and finally the higher peaks of the Andes, at an elevation of 15,000 feet, became mantled with perennial snow, and on the eastern flanks of Chimborazo, which intercepts the moisture of the Atlantic trades, glaciers established themselves. We thus see how, within Quaternary times, temperate and alpine zones became established over the vast Andean plateau, originally, perhaps at the end of the Pliocene, a plateau of the third order, clothed with vast forests like those of Brazil and Venezuela.

In Patagonia, likewise, the elevation of the Cordillera, and the change of level of the low lands of the eastern coast, now well-known to have happened, are they not sufficient to account for the extinction of the fauna of the pampas?

The same phenomena obtained in Western North America. Throughout the Tertiary period there was in the northern portion of the plateau region a secular rise of land, if not at times paroxysmal, resulting in the drainage of the plateau into the Pacific and the formation of vast inland seas and estuaries which eventually became fresh-water lakes.

During the Laramie epoch the Rocky mountain plateau became dry land, and the elevation and drainage went on during the Eocene. The Gulf of Mexico was much larger in the Eocene epoch than now; afterwards the coast of Texas rose from 300

to 7000 feet, while farther north, in Colorado and Wyoming, the Rocky mountain plateau rose from 4000 to points 10,000 feet above the ocean.

The plains east of the Rocky mountains are underlaid by beds deposited by vast inland, fresh-water lakes. In Texas these beds dip under the Gulf of Mexico, but at the base of the Rocky mountains in Colorado they are 7000 feet above the sea. They have been tilted up. Gen. Warren and Mr. King have shown that after the Pliocene epoch such a tilting took place. These lakes dried up, and the marvelously abundant mammalian life which thronged about their shores became extinct as the Quaternary period opened. May not the extinction of life so widespread throughout the West, particularly at the end of the Eocene, the Miocene and the Pliocene, have been mainly due to the great changes in the physical geography of that vast region? We see also why a semi-tropical climate and flora and fauna continued to exist around the Gulf of Mexico, but ceased to live on the elevated Rocky Mountain plateau, as well as the Sierra Nevada and Cascade plateaus. The whole western portion of the continent was carried up bodily, the lakes drained off by the Missouri, Columbia and Colorado rivers and the air at such an elevation becoming rarified, dry and cooler, the tropical life became either extinct or migrated southward to warmer and lower regions. Towards the end of the Pliocene multitudes of llamas, droves of horses, mylodons, elephants and mastodons, with lions, cats and dogs, flourished in Oregon, Montana, Utah, Wyoming, Colorado and New Mexico; changes of level and consequently of climate were perhaps the main factors concerned in their demise.

There were throughout the Tertiary most widespread and all pervading geological changes, culminating in the upheaval of the two great mountain chains of the West. Horizontal Cretaceous strata lie on the Rocky mountains at an elevation of 10,000 feet, the sign and proof of an extensive upheaval. We know that the movement in South America, while gradual for the continent, was more or less locally paroxysmal. Was it not the case also in North America?

By the end of the Pliocene, North America assumed its present continental proportions. The Rocky mountains and Sierras shot their peaks into the sky to elevations of 10,000 and 15,000 feet above the Pacific. These great walls shut off the moist trade winds

from the Pacific, a period of dessication set in throughout the great basin between the Rocky mountains and Sierra Nevada, and extensive rainless districts resulted. But even then there were alternate wet and dry cycles throughout the early Quaternary. Great Salt Lake, from being a vast body of fresh water, became a shallow brine pool; the sources of the Colorado, Columbia and their tributaries likewise partially dried up.

Finally, the Glacial epoch came in, the glaciers invaded Northeastern America; these on the one hand, and the great elevation of the western plateau, seem to have been the causes which removed the Pliocene fauna; which removal was, geologically speaking, comparatively sudden.

Either at the end of the Pliocene or beginning of the Quaternary, as seen by the bones in the Port Kennedy cavern described by Professor Cope, there was a singular mixture of what we now regard as tropical and temperate forms living so far north as Pennsylvania; with the tapir, peccary, Mylodon, Megalonyx, Castoroides and sabre-toothed tiger, were apparently associated the deer, bison, horse, porcupine, raccoon, dog, weasel and smaller mammals. The fauna was in part extinguished by the glacial cold, Port Kennedy being situated a little south of the edge of the great glacier.

The result of a change of climate was a change in the nature of the forests; the tapir and peccary were forced to migrate southward; the colossal sloth and sabre-tooth tiger died outright; the Castoroides, horse and mastodon lingered through the Glacial epoch, their remains being found at the bottom of swamps, but above the glacial and river drift; while the deer, bison, raccoon, dog or wolf, and other forms survived with unimpaired vigor and became adapted to a lower climate, forming the typical members of the north temperate fauna of America.

Farther south, in the river gravels and caves of the Middle and Southern States, are found the bones of the great sloths, Megatherium, Megalonynx and Mylodon, the American lion and bear; these were possibly swept out of existence by the cooler winters of the Mississippi valley, which was free from ice, but probably had from their proximity to the great glaciers a lower climate than in Pliocene times.

Professor Cope remarks: "Since the Eocene, the mammalian fauna of the northern hemisphere has diminished in number of

species and genera. The Eocene fauna was richer than the Miocene, the Miocene than the Pliocene, and the Pliocene than the modern fauna." There is certainly a significant parallelism between the widespread changes in the physical geography of North America, the differentiation of climates and of faunal areas, and the increasing extinction of life.

The West Indies meanwhile were the scene of notable changes in the distribution of land and sea. From being much larger, and in some cases connected perhaps with South America, they became submerged. Cope has described the fossil remains found in a cave on the Island of Anguilla. Out of twelve species of mammals, seven are extinct and several were chinchillas of large size.

About the shores of the Mediterranean there were remarkable changes in the relations of land and sea. The species of dwarf and other elephants whose bones have been discovered on the Island of Malta, show that within recent times that island must have been connected with the main African continent.

In the old world, simultaneously with the mountain-building of America, the Alps during the later Pliocene attained their present proportions; the Himalayas rose to their present heights; the continents of Asia, with Europe, and of Africa assumed their present outlines.

The extent and nature of the changes which took place late in the Pliocene in the physical geography of the globe were without doubt much greater than at any previous time in the history of our planet. While the present coast lines were being established volcanic agencies were widespread and powerful, and over what were then regions of intense volcanic activity are to be now seen but the dying embers of subterranean fires.

The long, quiet preparatory eons of the Mesozoic and early Tertiary, were succeeded by a crisis in geological history, just as the comparative quiet of the Palæozoic age terminated in the widespread disturbances which took place at the end of the Coal period.

If we glance back through the geological ages we shall see that there were cases of the comparatively rapid extinction of types or whole groups of animals. The more remarkable were the extinction of the trilobites and ammonites. Darwin remarks: "The extermination of whole groups, as of ammonites toward

the close of the secondary period, has been wonderfully sudden."

In the same manner the trilobites as well as the Eurypterida ceased to exist at the end of the Palæozoic age; the Silurian graptolites disappeared with comparative suddenness; the crinoids and brachiopods mostly, and the dinosaurs and ornithosaurs, as well as pythonomorphs wholly perished during the Cretaceous period.

The views we have presented, while opposed to ultra-uniformitarian ideas, have nothing in common with the Cuvierian catastrophic doctrine of sudden, wholesale extinctions and re-creations. But known facts in palæontology postulate long periods of quiet preparation, succeeded by more or less sudden crises, or radical changes in the physical structure of continents, resulting in catastrophies, both local and general, to certain faunas or groups of animals, as well as individual species.

The biological changes were not due to climatic and geological changes alone, but it should be borne in mind that the great changes, slowly induced but not without striking final results, ending in the addition or loss of vast areas of land, induced extensive migrations, the incursions of prepotent types which exterminated the weaker. The reaction of one type of life upon another, the results of natural selection, were apparent all through; but these secondary factors were active both during periods of quiet and periods of change. Here again we may quote from Darwin, the leader, next to Lyell, of the uniformitarian school, who remarks: "We have every reason to believe, from the study of the Tertiary formations, that species and groups of species gradually disappear, one after another, first from one spot, then from another, and finally from the world. In some few cases, however, as by the breaking of an isthmus and the consequent irruption of a multitude of new inhabitants into an adjoining sea, or by the final subsidence of an island, the process of extinction may have been rapid."

Local extinctions due to local changes of level; the formation of deserts, saline wastes and volcanic eruptions and vast outpourings of lava, such as took place in Oregon and Idaho during the Tertiary, with sub-marine earthquakes causing the death of fishes on a vast scale, these are quite subordinate factors.

In closing this meager sketch of a subject which has not re-

ceived very much attention, we have endeavored to attract notice to what we have been accustomed to regard as the main factors in the extinction of species and of higher groups. That there is a limit to the age of species as well as to individuals almost goes without saying. As there is in each individual a youth, manhood and old age, so species and orders rise, culminate and decline, and nations have risen, reached a maximum of development and decayed. The causes, however complex, are, in the case of plants and animals, apparently physical; they are general and pervasive in their effects, and have been in operation since life began; there have been critical periods in palæontological as well as geological history, and periods of rapid and widespread extinction as well as a continual, progressive dying-out of isolated species. Such extinction was, so to speak, a biological necessity, for otherwise there would have been no progress, no evolution of higher types.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

——In entering upon the twentieth year of the publication of this magazine, the friends of the undertaking may congratulate themselves on its signs of good health and strength, as seen in the portly appearance of the later volumes. Having passed through the perils of infancy and childhood, may we hope that in entering upon years of maturity it will, with each volume, gain in strength and character as an exponent of American natural science.

While the magazine has doubled in size, the number of departments and of assistant editors has correspondingly increased. More space is given to reports of scientific discoveries so as to render the magazine more useful to science-teachers, and the working naturalist.

Our great need is, more numerous plates and cuts; to secure this end our friends are urged to aid in enlarging our subscription list.

Our hearty thanks are due to the public for its support, and to our contributors and assistant editors. Depending on their aid and good will we hope to make the future volumes of the NATURALIST still more deserving of public support and esteem.

——The proposition to create an Academy of Sciences of the State of Indiana, suggests some reflections as to the future of such bodies in the United States. It has appeared to us desirable that each State should have, at some future time, its academy of sciences, but we have refrained from enlarging on the topic, since it is plain that, as regards the greater number of States, the time has not yet arrived. But Indiana now comes to the front, and if she succeeds in establishing a real academy of sciences, she will hold the place of honor in our history. There is no doubt that among the men of her leading schools, her geological surveys, etc., she has the material for the organization of such a body. In most of the States there is no material out of which to make an academy of sciences, and in none is there much material.

Of course all are agreed that merit only shall be the test of membership in such a body; but all are not agreed as to what the test of merit ought to be. There can, however, be but one test, and that is the one which has been adopted in the old countries, and by our own National Academy in recent years, and that is the test of *meritorious work done.* It may be that this is an imperfect guide to the merits of some men, but it is the best we have, and the one open to the fewest objections. Moreover the estimation of the merit of work done should be guided by the attribute of quality rather than of quantity, and chiefly by the quality of originality or novelty. There are many meritorious compilations, but the best of them stand in the second rank of merit. The first rank is held by the discovery of new truths. As the amount of truth yet to be learned far exceeds that which has been acquired hitherto, its discovery is the business of the scientific man. Since the truths that lie at the foundation of a majority of phenomena are yet unknown, the work of compilation had better be left to those who for any cause whatever are incapable of original research.

In the first organization of an academy of sciences, the seeds of its future success or failure are sown. The admission of persons to membership who regard science as a mere ornament, or amusement, will vitiate its future life. Still more will the entrance into its councils of persons who regard membership merely as a step to personal advancement. In many portions of this country, especially in some regions where intelligance is not wanting, the fact of the specialization of men's abilities is not sufficiently ad-

mitted. In such communities it is still believed that, intellectually speaking, "all men are born equal," or nearly so. In such places a fluent expression of interest in some form of human progress, will be regarded as identical with ability to aid in that form of human progress.

Since academies of sciences in this country are not yet sustained by government grants, it will be necessary to have a lay membership, whose annual dues will meet the necessary expenses. There should therefore be two degrees of association, viz., membership and fellowship; the latter to be conferred exclusively on persons who have contributed important work to the progress of science, chiefly of original research. Such fellowship becomes an order of merit, which serves both as a stimulus and as a reward for work.

The local academies of science hitherto established, generally possess libraries and museums. This property may become a great evil, as, for instance, when its conservators claim equal place in the councils of the academy with the scientific men. But it could be administered by a financial or property committee of lay members, who should act with the fellows, when management of financial matters is in question.

—— The numbers of the AMERICAN NATURALIST for 1885 were issued at the following dates: January, Dec. 30th, 1884; February, Jan. 19th, 1885; March, Feb. 24th; April, March 21st; May, April 20th; June, May 18th; July, June 20th; August, July 28th; September, Aug. 15th; October, Sept. 22d; November, Oct. 23d; December, Nov. 25th.

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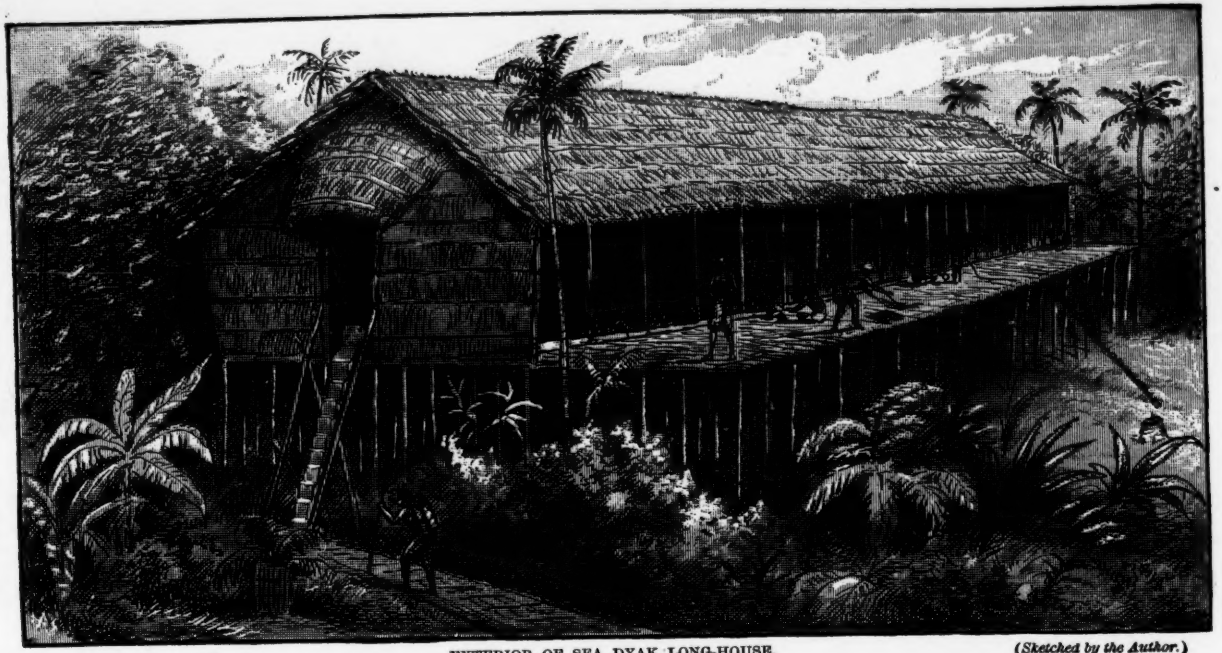
RECENT LITERATURE.

HORNADAY'S TWO YEARS IN THE JUNGLE.[1]—The author spent two years in the East Indies dividing his time between India, Ceylon, the Malay peninsula and Borneo, collecting specimens for Ward's establishment at Rochester. Wherever he went Mr. Hornaday kept his eyes open. Of apparently a hardy, iron constitution, which was not subdued by repeated attacks of the jungle fever, of great industry and bravery, and withal a good story-teller, the result is one of our best books of travel in countries which have been ransacked by English and German travelers. The interest of the narrative is sustained throughout, and if at times too much slang is introduced, we forgive these slight derelictions in view of the manifest honesty, kind-heartedness and scientific zeal of the author. Though by profession a taxider-

[1] *Two Years in the Jungle.*—The experiences of a hunter and naturalist in India, Ceylon, the Malay peninsula and Borneo. By WILLIAM T. HORNADAY, with maps and illustrations. New York, Charles Scribner's Sons. 1885. 12mo, pp. 512. $4.00.

PLATE II.



EXTERIOR OF SEA DYAK LONG-HOUSE. *(Sketched by the Author.)*

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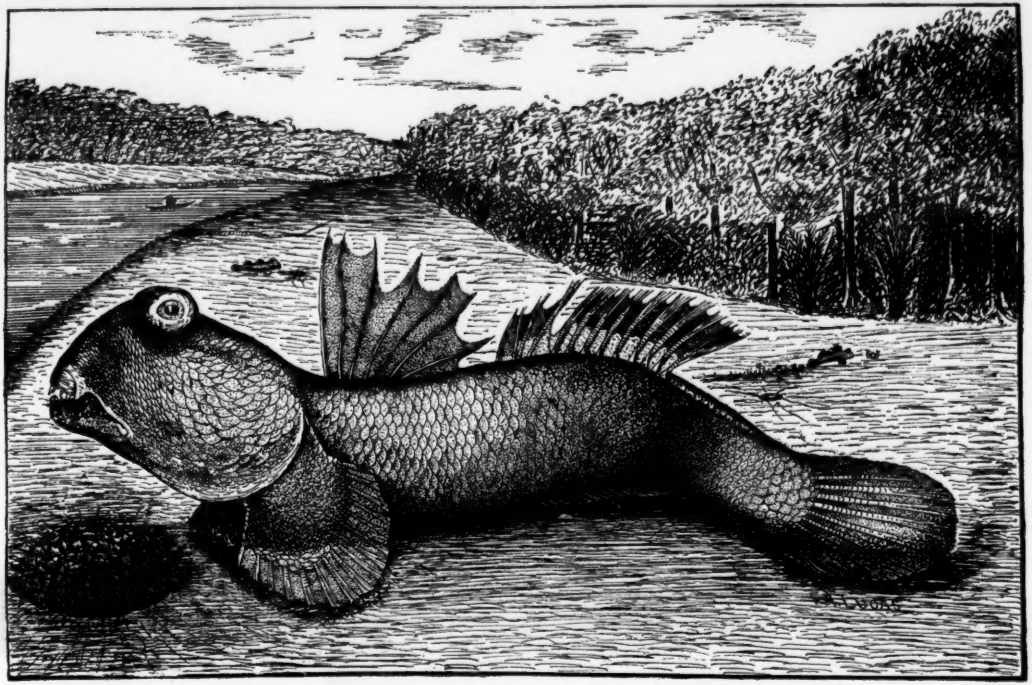
PLATE III.



THE JUMPING FISH.—(PERIOPHTHALMUS SCHLOSSERII.)
(Drawn by F. A. Lucas, from a specimen.)

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mist and collector, Two Years in the Jungle abounds in observations on the physical geography, ethnography, zoölogy and botany of the countries visited. We get a clear idea of Western India, its people, their castes, of British rule, on the whole so beneficent, as well as how to skeletonize elephants, skin monkeys, crocodiles, tigers, snakes and orangs. The maps are convenient and the illustrations numerous, new and fresh, if not always excellent from an artistic point of view. These which we have been permitted to introduce are fair specimens of the plates. Among the more valuable contributions to zoölogy are the portions refering to the elephant, its natural history and psychology, the crocodiles and gavials, the orangs and gibbons, the sharks, particularly that strange connecting link between the sharks and skates, Rhamphobates, down to the jumping fish. If Mr. Hornaday in slaying elephants showed rare nerve and skill as a marksman, quite another set of qualities were brought into play in catching these odd fish. These creatures live on the mud flats of the Siamese rivers, hopping about over the deep mud, feeding on the tiny crustaceans left on the bank by the receding tide; but we will let the author tell the story in his own way:

"The Malays were thunderstruck when I pulled off my shoes and told them to put me ashore. Seeing that I was really going, Francis, like a good boy, did not hesitate to follow, and we stepped out of the sampan into mud and water hip deep.

"We will never know the actual depth of the mud on that bank, but we sank into it to our knees at every step, and were fortunate enough to stop sinking at that point. What a circus it must have been for those who looked on! But, in for a penny in for a pound, and bidding Francis choose the largest fish when possible, we went for them. There were probably a dozen in sight, hopping spasmodically about, or lying at rest on the mud, but when we selected the nearest large specimens and made for them, they developed surprising energy and speed, and made straight for their burrows. They progressed by a series of short but rapidly repeated jumps, accomplished by bending the hinder third of the body sharply around to the left, then straightening it very suddenly, and at the same instant lifting the front half of the body clear of the ground by means of the arm-like pectoral fins which act like the front flippers of a sea lion. These fins are almost like arms in their structure and use, the bones being of great length, and thus giving the member great freedom of movement. Owing to the soft and yielding nature of the mud the leaps were short, about six inches being the distance gained each time, but they were so rapid, the mud so very deep and our progress so slow, the fish always succeeded in getting into their holes before we could reach them. Their burrows were simply mud holes, going straight down to a depth of three to four feet, large enough in diameter to admit a man's arm easily, and, of

course, full of water. Although the mud was soft, it was not sticky, and we were able to use our hands for spades very effectually. By digging a big hole two feet deep, and standing on one's head in the bottom of it, we were able to reach an arm down two feet farther and seize our fish at the bottom of the burrow. Lucky it was for us that they had no sharp and poisonous spines, like the mud-laff which stung me in Singapore and paralyzed my right hand for some hours.

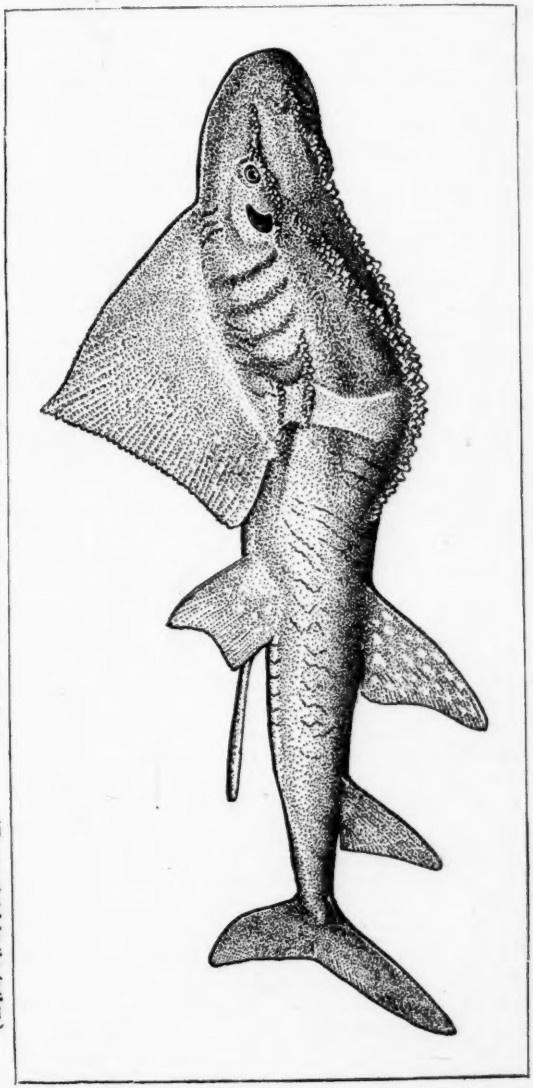
"My first fish was hard to get and hard to hold, but in the immortal words of *The Shaughraun*, 'Begorra, 'twas worth it.'"

In hunting tigers and elephants, the most dangerous game in the world, Mr. Hornaday proved himself a mighty Nimrod. He naturally has much to say of the elephant, and we are surprised to learn that in such a populous country as India the animal is on the increase. Though at present they are rigidly protected by law, it is evident that their number will soon increase to such an extent "as to render further elephant shooting positively necessary."

The height of the Indian elephant is, the author claims, like that of nearly all large animals, usually recorded in exceptional figures. "Even the best scientific writers are apt to fall into the habit of giving the largest measurements fairly obtainable, which therefore brings the average animal far below the standard they set up. I can scarcely recall an instance of having shot a mammal, even out of a score of the same species, which came up to the measurements recorded by Jerdon in his Mammals of India. The height of the male *Elephas indicus* should be recorded as nine feet six inches, vertical measurement, at the shoulder, and the female eight feet, for these figures represent the height of from eight to twelve individuals to be found in every hundred; in other words, animals which can be seen without searching throughout the length and breadth of India."

The height of the Indian elephant is everywhere recorded as from ten to ten and a half feet, but the largest one ever measured "was a tusker described by Mr. Corse in 1799 as belonging to Asaph-ul-Daula, a former Vizier of Oudh, which really measured ten feet six inches, perpendicularly at the shoulder. This animal was merely one out of ten thousand, and it would be quite as sensible to measure Chang and record the height of Chinamen as being seven and a half feet, as to say that the Indian elephant is as tall as the Vizier's giant."

Our author spent a month with the Dyaks in Borneo, orang hunting, his trophies now adorning the National Museum at Washington. His account of the two species of orang (*Simia wurmbii* and *satyrus*) inhabiting Borneo, is detailed, and stamped with the mark of accuracy. The nesting habits were observed and described as follows: "I got there just in time to see the orang build a large nest for himself. He took up a position in a



RHAMPHOBATIS ANCYLOSTOMUS. (GILL.) (*From a sketch by the Author.*)

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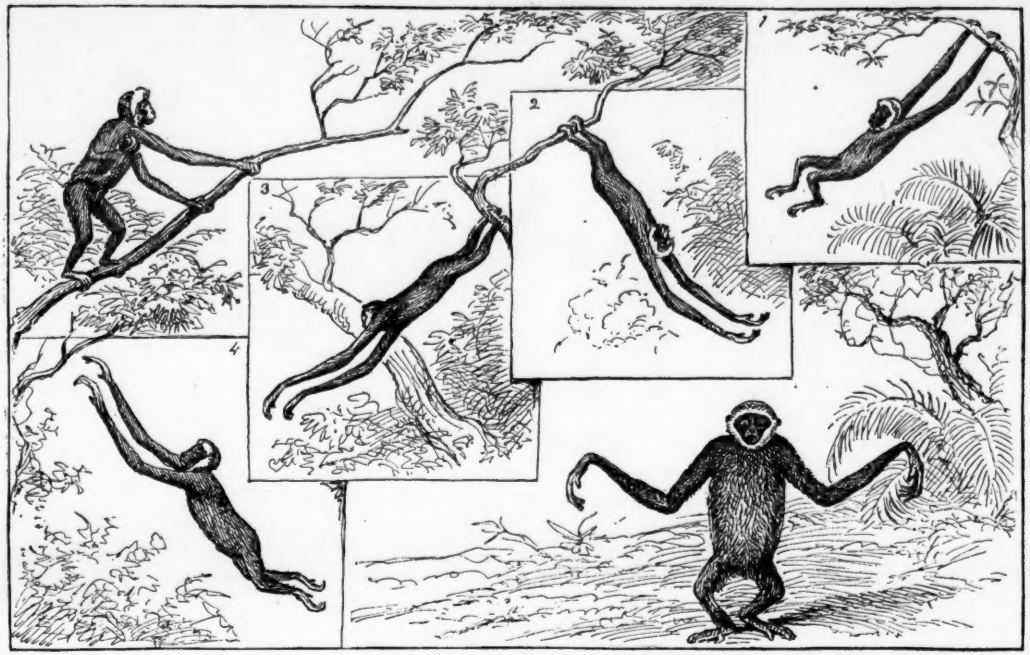
PLATE V.



THE GIBBON'S MODES OF PROGRESSION. *(From sketches by the Author.)*

1-4. Swinging through the tree-tops.—5. Walking on level ground.—6. Climbing through the tree-tops.

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fork which was well screened by the foliage, and began to break off small branches and pile them loosely in the crotch. There was no attempt at weaving, nor even regularity in anything. He reached out his long, hairy arm, snapped off the leafy branches with a practiced hand, and laid them down with the broken ends sticking out. He presently got on the pile with his feet, and standing there to weight it down he turned slowly, breaking branches all the while and laying them across the pile in front of him, until he had built quite a large nest. When he had finished he laid down upon it, and was so effectually screened from us that I could not dislodge him, and after two or three shots I told the natives they would have to cut the tree." During one day's travel along the Upper Simujan river, Mr. Hornaday counted thirty-six old nests and six which were regarded as new or fresh. He thinks that an orang after building a nest sleeps in it several nights in succession, unless he leaves its neighborhood altogether. He never saw nor heard of any house-building by orang-utans, though he was led to believe that some individuals may have a habit of covering their bodies with branches for protection against the dashing of the rain drops during a heavy storm. "My little pet orang," he says, "would invariably cover his head and body with straw or loose clothing the moment it began to rain, even though he was under a roof."

Forty-three orangs were shot by Mr. Hornaday and his hunters, and of these seven exceeded the maximum height as given by Mr. Wallace, viz., four feet two inches. "My tallest *Simia wurmbii* or 'mias chappin,' measured four feet six inches from head to heel, and the next in size four feet five and a half inches. Then a *satyrus*, or 'mias rombi,' measured four feet four and a half inches, two other *wurmbii* four feet four inches, and four feet three inches respectively, a *satyrus* four feet three inches, and a *wurmbii* four feet two and a half inches."

The account of the gibbons and other animals of Borneo, its forests and of the Dyaks are interesting—indeed there is not a dull page in the book. Besides the general map there is an ethnographic map of Borneo, showing the distribution of the Dyak tribes and subtribes, as classified by the author. Much ethnographic material is given, with frequent illustrations. We see little in point of fact to criticise, except where the author speaks of nummulites as "little flat echinoderms."

GOODALE'S VEGETABLE PHYSIOLOGY.[1]—Early in the past year we had the pleasure of noticing the first part of this work, which is now completed by the appearance of Part II. The chapters in the part before us deal successively with, Protoplasm in its rela-

[1] *Gray's Botanical Text-Book* (Sixth Edition), Vol. II. Physiological Botany. II. Vegetable Physiology. By GEORGE LINCOLN GOODALE, A.M., M.D., Professor of Botany in Harvard University. Ivison, Blakeman, Taylor & Company, New York and Chicago, 1885. pp. XXI. 195 to 500+36. Illustrations 142 to 214.

tions to its surroundings; diffusion, osmosis and absorption of liquids; soils, ash constituents, and water culture; transfer of water through the plant; assimilation; changes of organic matter in the plant; vegetable growth; movements; reproduction; the seed and its germination; resistance of plants to untoward influences. The whole volume thus covers the field of the general anatomy and physiology of plants, and especially of the flowering-plants.

In looking over the chapters one is struck with the fact that in them much new material has been brought for the first time before the American student. There is thus a freshness about much of the matter which adds greatly to its interest. The treatment, too, is sufficiently different to distinguish the book at once from others covering the same general ground. Very naturally the work has much of the German method in it. In fact a great part of the matter is the result of work done in German laboratories.

A noticeable feature of the book is its wider range of subjects than is usual in botanical works. There is much in it which we are accustomed to consider as belonging to agriculture and agricultural chemistry. This feature will commend the book to the teachers and students in our agricultural colleges. We have thus in chapter VIII such topics as the following taken up and discussed at some length, viz: Formation of soils; classification of soils; condensation of gases by soils; temperature of soils; etc., etc. In chapter XVI we have discussed the following practical topics, viz: Winter killing; improper food; noxious gases; liquid and solid poisons; mechanical injuries.

The chapters which interest us most are the tenth, eleventh and twelfth, devoted respectively to assimilation, change of organic matter in the plant, and vegetable growth. In the first there is some danger of confusion from the double sense in which the word assimilation is used, viz: 1, For the conversion of all food-matter (in which sense it is employed in the heading to the chapter and headings of the pages throughout the chapter), and 2, the appropriation of carbon. This last is called assimilation proper (p. 285), and a few lines further on the statement is made that "the term *assimilation* in the following pages will be made to refer to the appropriation of carbon." Aside from this confusion of terms, the treatment is exceedingly satisfactory. In the eleventh chapter the word transmutation is used in place of the usual one, metastasis, or the less usual one, metabolism. This appears to us to be a desirable improvement in the nomenclature of the subject.

The chapter on vegetable growth brings before the student the latest results of the German investigators, and this is done in so clear and concise a manner as to leave nothing to be desired. The author has sifted the great mass of literature upon this subject and given in summary form the results.

The illustrations throughout the volume are drawn mainly from

the publications of Pfeffer, Sades, Darwin and others, and in many cases have been reduced in size by the publishers so as to give them a better appearance upon the octavo pages. The printer's work has been well done, and the book has an attractive appearance.—*Charles E. Bessey.*

WOOD'S NATURE'S TEACHINGS.[1]—Mr. Wood has written a good many books on zoölogical subjects, all useful, but none of them particularly profound or especially inspiring, but we think that in the present case he has produced a most readable book. The object of the writer is to show the close connection between the actions of the different organs of animals and plants and human inventions, and to prove that there is scarcely an invention by man which has not its prototype in nature. The author has placed side by side a great number of parallels of nature and art, with terse, brief descriptions, and illustrated with a great number of original sketches. As a result, we have just the book to put into the hands of a boy, not only serving to interest him but to lead him to observe the common objects of nature; and grown-up people will also, if we mistake not, relish its pages and illustrations. The author draws the corollary from the facts presented, "that as existing human inventions have been anticipated by nature, so it will surely be found that in nature lie the prototypes of inventions not yet revealed to man."

As examples, the raft with its sail is anticipated by the Velella; the boat by the gnat-egg boat, the floating sea-anemone, or water-sail or pupa-skin of the mosquito; and the boatman in his boat by the "water-boatman," or Notonecta. Examples of paddle-wheels are seen in those of the Ctenophores, and the movements of the tail of the fish anticipate those of the propeller. The arrangement of the ribs of a fish are like those of a vessel, while the form of a ship's anchor is outlined in the spicule of the Synapta, and that of a grapnel in the spicules of sponges and Echinococcus; ice-anchors and ice-hooks are anticipated by the tusks of the walrus; an eagle's claw presages a flesh-hook, and the grapple-plant the ordinary drag; boat-hooks are typified in the pushing spikes of sea worms; Captain Boynton's life-dress in the float of a Portuguese man-of-war, and Janthina's raft in a cask-pontoon. Under the caption of war and hunting, pitfalls are shown to be but an imitation of that of the ant-lion, and poisoned arrows of the fangs of serpents and the stings of insects. Barbed spears, harpoons and arrows have multitudes of semblances in nature, as do projectiles of all descriptions. Nets, traps, defences of all sorts, armor of varied description, forts, scaling implements, tunnels, as well as the houses of savages, and the porches, eaves, windows, thatch, slates and tiles of civilized architecture, with

[1] *Nature's Teachings.* Human inventions anticipated by Nature. By Rev. J. G. WOOD, with upwards of 750 engravings. Boston, Roberts Brothers. 12mo, pp. 533.

girders, ties, buttresses, dovetailing, and varnish, all existed in nature before man conceived them. So with spades, scissors, chisels, the plane, saw, boring, striking and grasping tools. Philosophic toys, fans, water-rams and paper-making—in short, many of the arts of every-day life are the reflections of nature. The book is full of curious facts, and set forth in a plain, simple, attractive style.

REPORT OF THE STATE GEOLOGIST OF NEW JERSEY FOR 1884. Geo. H. Cook, Director.—From this report we learn that the geodetic survey of New Jersey is completed except in the interior of the southern part, and that the topographical survey has completed over three-fifths of the total area. The volume includes notices of the buried forest near South Amboy, consisting of chestnut, oak, cedar, etc., in complete preservation, and probably buried since the settlement of the country; of the glacial drift and yellow sand and gravel; of the continuation of the plastic clays, marls, etc., of the Cretaceous and Tertiary strata under the ocean for one hundred miles; of the now celebrated columnar trap rocks of Orange mountain; of the Devonian, Silurian and Archæan areas of Northern New Jersey; of the mines and mining industry; artesian wells, etc., of the State.

Perhaps the most interesting result given is that the slope of the sea bottom beyond the continental plateau is almost exactly the same as the dip of the Cretaceous strata. The presence of the Cretaceous beds in the marginal deposits of the ocean, as proved by borings, seems to prove the Pre-cretaceous age of the ocean bottom.

FOURTEENTH ANNUAL REPORT OF THE GEOLOGY AND NATURAL HISTORY SURVEY OF INDIANA. John Collett, Director.—This volume is accompanied by a geological map giving a fair exhibit of the surface geology of the State. The topographical and geological features of Madison, Hamilton, Fayette and Union counties, are given more in detail, and Dr. J. S. Newberry describes the drift deposits of the State. The volume closes with an account of the mammalian fauna of the Post-pliocene deposits, by Professor E. D. Cope and J. L. Wortman. The Artiodactyla are *Platygonus compressus* and *Cariacus dolichopsis;* the Proboscidea, *Elephas primigenius* and *Mastodon americanus;* while the Rodentia are represented by the singular *Castoroides ohioensis*, an animal exceeding the capybara in size, and, spite of its name, differing widely in character from the beaver. *Megalonyx jeffersoni* represents the sloth-like edentates, and the genus Equus has left the remains of two species, *E. fraternus* and *E. major*, in the Pliocene and Post-pliocene of Indiana.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA.—*The Trigonometrical Survey of India.*—At the meeting of the British Association, held at Aberdeen in September of this year, the president of the geographical section, General J. T. Walker, gave an account of the survey of Hindostan. Survey operations along the coast-lines began before the commencement of the seventeenth century, and the first general map of India, published by D'Anville in 1752, was compiled from the charts of coast-lines and the itineraries of travelers. Major Rennell, appointed surveyor of Bengal in 1764, was the father of Indian geography. In nineteen years he surveyed 300,000 square miles, and after his return to England, published a great work on Indian geography. At the close of the last century Major Lambton drew up a project for a general triangulation of Southern India. He commenced work by a careful triangulation of Southern India, but for several years no notice was taken of his import-

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

ant services to science. In 1817 the French institute elected him a corresponding member, and after this honors and applause followed from his own countrymen. His assistant, Captain Everest, discovered that Lacaille's meridional arc, at the Cape of Good Hope, was in error through the deflection of the plumb-line at the ends of the arc, under the influence of the attraction of the neighboring mountains, and thus became aware of the necessity of placing astronomical stations where this cause would not be active. Everest introduced great improvements into the methods of the survey, which, before Lambton's death, had been extended in its scope to embrace the whole of India, and his methods were followed until the completion of the principal triangulation. Many of the forest regions of India are most pestilential. Native troops mutinied at being taken into the Godavery basin, for fifty years the chain of triangles passing through it remained untouched, and its execution cost the life of the officer in charge. The Terai, at the base of the Nepalese Himalayas, was still more formidable, yet, owing to the refusal of the Nepalese government to permit Europeans to enter their territory, a connecting chain of triangles had to be carried along its 500 miles, necessitating the clearance of some 2000 miles of line through forest and jungle, and the construction of over 100 towers to overlook the earth's curvature. The mortality was greater than in many a famous battle. In 1843 Everest was succeeded by Waugh, who retired in 1861, and the last chain of the principal triangulation was completed in 1882.

The two longitudinal arcs first measured in India were employed by Colonel Clarke in his last investigation of the figure of the earth, and General Walker stated his belief that they are the only two arcs sufficiently accurate to be thus used. These investigations show that the equator has much less ellipticity than was formerly believed, and that the major axis is 8° 15′ west of Greenwich, instead of 15° 34′ east of it, as was previously supposed. The French meter, supposed to be a ten-millionth part of the earth's meridional quadrant, is now known to be nearly $\frac{1}{5000}$th part less than the magnitude it was intended to represent.

Mr. Hosie's Travels in China.—At the recent meeting of the British Association Mr. A. Hosie gave an account of three journeys in Southwestern China made by him since the beginning of 1882. The first was through Southern Ssu-ch'uan and Northern Kweichou to its capital, Kwei-yang-Fu, westward to Yunnan Fu, then through Northern Yunnan and along the Nan-kuang river to the Yang-tsze, where he took boat to Ch'ung-ch'ing, his starting-point. In 1883 he passed to Ch'êng-tu, the capital of Ssu-ch'uan, by way of the brine and petroleum wells of Tzu-liu-ching, then through the country of the Lolos, then by Ning-yüan, in a valley famous as the habitat of the white-wax insect, to and through the mountainous Cain-du of Marco Polo, inhabited in

great part by Mantzu tribes. Reaching the Chin-sha Chiang or river of golden sand, he then proceeded to Ta-li Fu and Yunnan Fu, when he descended the Yung-ning river to Lu Chou. In 1884 he went to Ho Chou, north of Ch'ung-Ch'ing, thence through a cultivated and fertile country to Chia-ting Fu, on the right bank of the Min and thence south on the eastern side of independent Lolodom, to the river of Golden Sand at the town of Man-i-ssu. Chia-ting is the great center of sericulture in Ssu-ch'uan, and the chief insect wax-producing city in the empire. A day's journey from it is the famous mount O-mei, 11,000 feet high, sacred to the worship of Buddha.

Asiatic News.—The total forest area of British India is computed at 75,270 square miles.——Colonel Prejevalsky has again failed to penetrate into Tibet over the Keria mountains in consequence of the strenuous opposition of the Chinese.——Dr. Otto Finsch has explored 1000 miles of the coast of Northern (German) New Guinea, has discovered several good harbors, and has followed a large river thirty miles into the interior. The interior is mountainous, the plains near the sea are richly covered with trees and bush and well watered, the soil is of the richest fertility, and the natives are friendly. Dr. Finsch found no trace of minerals, and regards the reported discovery of gold on the Fly river as a "schwindel."

AFRICA.—*Somaliland.*—The October issue of the Proceedings of the Royal Geographical Society, contains F. L. James's account of his journey through the Somali country to the Webbe Shebeyli. The journey was in many respects the most successful that has ever been made in that region, since the party succeeded in penetrating Ogadayn, more than half crossing the peninsula, and returning without a contest. The return was, however, compelled by the attempt of the Sultan of Barri to make his visitors assist him against his rival. The greatest danger to which the travelers were exposed, arose from Lord Granville's telegram forbidding the expedition to proceed. This arrived after their departure, but its open publication in Berbera caused the Somali to believe that the travelers were in disfavor with the British government. Firearms were new to the Somali of Ogadayn, and the rifles insured respect. Most of the country appears to be a stony desert, but settlements are abundant on the Webbe, which does not reach the ocean, but loses itself a few miles from the coast. In Ogadayn there is a subject people called Adone, with strongly-marked negro features. About 150 species of plants, chiefly herbs and under-shrubs, were brought back, including a specimen of an apocynaceous plant which affords an arrow-poison. Sixty-one species of birds, seven of which are new, and forty-six kinds of Lepidoptera, seventeen of them new, were also brought back. The genealogy of the Somali tribes is given. They are all said

to be descended from two brothers, Darode and Tsak, Ogadayn was a son of the former.

The Lake Mœris.—Mr. Cope Whitehouse described to the British Association the basin of the Reian Mœris in Egypt, and spoke of the possibility of the restoration of this historic lake. South of the Fayoum exists a depression of several hundred square miles, not less than 150 feet below the Mediterranean, and in the parts visited by the writer, 175 to 180 feet deep. The area is irregular, curving like a horn from near Behnessa to the ridge which separates it from the Fayoum. Ruins exist in its southern part. The level of the ruins proved that the ancient station of Ptolemais might have been as shown in the text and maps of Ptolemy, on a horn-shaped lake about thirty-five miles long and fifteen wide.

The Kassai Tributary of the Congo.—Lieut. Wissman speaks enthusiastically of the Kassai as a magnificent fluvial artery, frequently of enormous breadth, leading into the heart of the new Congo State. The country on its banks is of wonderful fertility. During the forty-two days occupied in the voyage from Luluaburg to Kwamouth, the health of the expedition was excellent, the five whites and 200 negroes all arriving in good health at Leopoldville on July 16th. The Sankaru and Lubilash are one river, which turns westward, and joins the Kassai. The Kassai receives the great Koango, and enters the main river by the Kwamouth, after receiving the waters of Lake Leopold.

African News.—The country between Blantyre and Quillimane has been described by Mr. H. E. O'Neill and Mr. D. J. Rankin in the Proceedings of the Royal Geographical Society. The Portuguese authority has recently been considerably extended up the Shiré towards Lake Nyassa.——The Kassai, the great southern tributary of the Congo, instead of entering the main stream north of the equator, joins it in 3° 13′ S. lat.——Mr. D. D. Veth, leader of a Dutch expedition into Portuguese West Africa, died on May 10th, between Benguela and Humpata.

GEOLOGY AND PALÆONTOLOGY.

Internal Chemical and Mechanical Erosion a Factor in Continent and Mountain Building.—As soon as it is affirmed that since early Laurentian times the great continental folds and depressions have not changed places, so soon it becomes necessary to explain how these great ridges and troughs have persisted, as such, in spite of the amount of erosion and sedimentation which are known to have taken place and which we know to be still going on at no small rate. Either the pre-Laurentian inequalities of surface were vastly greater than they are now, or else, during all the ages the ocean beds have been constantly receiving sediment and sinking, while the continents have been as constantly eroded and rising. But this latter hypothesis implies

that there has been and is a continuous circulation of the material of the solid land from the continents to the ocean, and from the ocean back to the continents again, a circulation, in some degree, like what is taking place in the ocean between the equator and the poles, that is, a bodily transfer of superficial materials one way and a slow general under-creep of materials back.

But how is such a system possible and how can it be maintained? If we assume, as appears to be required by both physical principles and geological facts, that the earth's surface is only slightly out of equilibrium and is constantly tending toward that state, then any transfer of material from the continents to the ocean would cause a subsidence of the ocean beds which, in turn, must necessitate a setting of the deeper earth materials from beneath the ocean beds toward the continents causing them to rise. This circulation appears to be entirely possible and even probable, if not almost certain, and this too, while granting that the earth is essentially solid throughout and as rigid as glass. By this is meant, of course, as rigid as glass would be under the internal earth pressure.

It appears to me, geologists have no occasion for dissenting from the views expressed by leading physicists in regard to the rigidity of the earth for, as I see it, there may be all the rigidity which physicists have claimed and yet all the mobility geological facts can demand. When cold metals are subjected to artificial pressure, causing their molecules to flow into new positions so that the form of the mass is greatly changed, it is not to be supposed that these metals while under such pressure are to be regarded as true liquids, in any sense obedient to all the laws of fluids, nor could any mere pressure, however great, convert them into true liquids. I think it will not be maintained, even by those who believe "pressure itself would reduce the interior of the earth to a fluid condition," that this fluid is such to the extent of permitting bodies moving freely through it as fish move through the sea; nor would they maintain that this interior fluid would remain such with the pressure removed. It could hardly be maintained either, that such a fluid would possess the degree of elasticity characteristic of true fluids, but unless these are insisted upon by geologists, physicists have all the rigidity they have claimed.

Even if it is admitted that such a circulation is possible when conditions are once favorable, unless there is some disturbing agent continually working to destroy the equilibrium which the circulation tends to establish, eventually the earth's surface must have existing differences of level greatly reduced. There appears no escape from the conclusion that the density of the earth increases as its center is approached. This being the case, a continual denudation from certain regions and constant sedimentation in others must, in due time, whatever may have been the original distribu-

tion of density near the earth's surface, remove all materials of low density from the continents and place them over the sea bottom, while the elevation of the denuded region would bring denser materials to the surface, thus tending to restore equilibrium with the two surfaces more nearly on the same level, unless there is some agent operating to reduce the average specific gravity of the continents.

If the earth does increase in density toward the center, this may be due: first, to a difference of chemical composition; or second, to increasing pressure; or third, to these two conditions in combination. With either the first or third conditions existing, and continued denudation with no counter agent, a leveling up would inevitably result. With the second condition existing, unloading in one place and loading in another of equal area, would permit of expansion in the continental mass and cause a compression of strata under the oceans, and might maintain the differences of level already established; but this view being very improbable, it remains to search for some cause which may reduce the specific gravity of the continents, and an adequate one, it seems to me, may be found in internal chemical and mechanical erosion.

Taking Mr. T. M. Read's estimate of chemical erosion (Am. Jour. Sci., April, 1885), at 100 tons per square mile annually on the average the world over, as a fair estimate of the work done by the waters which come to the surface before emptying into the ocean, it is plain that a vast work must be done in reducing the average specific gravity of the continents, unless it is maintained that the small cavities produced are closed by compression as fast as formed. This certainly is not the case in the superficial strata, nor can it be the case in the deeper strata where the cavities produced by solution remain filled with water.

Data are altogether too meager to allow of a quantitative treatment of the question. We do not know, for example, what proportion of the matter carried in solution to the sea by rivers annually is obtained through purely superficial action. Neither do we know what proportion of the water falling upon the continents enters the ocean below ocean level. It is reasonable to suppose that this amount is not small, and that the water entering the sea below ocean level carries a higher per cent of solids than the average river water. Now that our Government scientific work is being consolidated, it would seem eminently fitting that these fundamental questions should occupy the joint attention of the U. S. Geological Servey and the Signal Service, and they are possibly already under consideration.

This internal erosion, by excavating small cavities in the body of the continents, would lighten them without in the same degree lowering their surfaces, and existing differences of level would be longer, if not permanently, maintained, because in case the denser strata were to be thrust up into the heart of the continents, into the

region of aqueous action, they would be attacked by the water and their average specific gravity lowered. Now in case superficial erosion were to exceed internal erosion, the result would be a lowering of the continents; but any lowering of the continents would reduce the rate of mechanical erosion much faster than it would the chemical, because very feeble springs and the mere capillary updraught of saturated water, would remove the solid ingredients of the continents and place them in position to be drawn off to the sea by currents too feeble to bear much solid material in suspension. The specific gravity of the continents would, by this means, be continually lowered, and the oceanic areas as continuously loaded, and, for this reason, we might expect the continents and oceanic basins to persist. Again, even if we suppose the same degree of porosity to exist in the sedimentary beds under the ocean as exists in those of the continents and the materials of the two to have the same specific gravity, the same number of feet of sediment under the ocean would be heavier, volume for volume, than the land because, if for no other reason, the beds would be, in all probability, more fully saturated with water. Now Professor Ferrel has shown that the attraction of continental plateaus must be neglected in reducing both pendulum and barometric observations to sea level, and therefore they do not represent so much material added between a given station and the earth's center; that is, these earth masses, although possessing longer radii, are no heavier than equal sections in the ocean areas.

Assuming that the continents and ocean beds, with their superincumbent water, are essentially in equilibrium, and taking the average depth of the oceans as 15,000 feet and the average height of continents, above sea level, as 1000 feet, we could obtain a tolerably accurate estimate of the average specific gravity of the continents if we knew the average density of the rocks below the sea bottom, knowing, as we do, the specific gravity of 15,000 feet of superimposed matter. The specific gravity of the earth 400 miles below the surface is estimated at 4.0478 (U. S. Coast and Geodetic Survey, 1879), and our heaviest known rocks scarcely run above 3. From these considerations, and from what we know of the specific gravity of sedimentary rocks, we should not expect the sedimentary beds of the sea bottom to have a specific gravity much above 2.5. Assuming an average of 2.5 for the first 5000 feet below sea bottom and of 2.95 for the next 10,000 feet, then the average specific gravity of the continental mass required to exactly balance this would be 1.851, assuming, of course, that a surface of uniform density under both oceans and continents is reached at a depth of 30,000 feet below the sea level. Now considering the specific gravity to increase below 15,000 feet below sea bottom at the rate of .05 for every 10,000 feet downward, it would then be necessary to go to a depth of about thirteen miles below sea level to obtain an average density sufficiently large to

balance continental masses having an average specific gravity of 2.5. If the specific gravity does not increase downward as rapidly as the rate assumed, as we may infer from Mr. Pierce's table (U. S. Coast and Geodetic Survey, 1879, p. 200), then a still greater depth would be required to secure equilibrium. From these considerations it would appear that the superficial continental strata must have an average specific gravity much below 2.5 and, in order that this may be so, that much material must have been removed from within the mass.—*F. H. King, River Falls, Wis., May 12, 1885.*

Geological Survey of Belgium.—In 1878 a commission was appointed to undertake a more exhaustive investigation of the geology of Belgium than that embodied in the map of Dumont. The topographical map serving as a basis consists of 369 sheets. Each important group of formations is entrusted to one or more specialists, who are each furnished with two assistants, and trace the system completely across the country. Every actual outcrop of rock is marked on the map, and where the rock is fossiliferous the fossils are noted. Special attention is given to soils and subsoils, and care taken to express on the map the agricultural character of the ground. It is believed that one-third of the entire work of the survey is now completed. By a novel system of broad washes of subdued tints, M. Dupont, the head of the survey and Director of the Royal Museum at Brussels, contrives to show the surface deposits, as well as the formations below, which are shown in deeper tints; while shaded lines of the proper color mark the margins of the stage. Professor Archibald Geikie expresses in *Nature* his conviction of the success of the new system of cartography.

The Bed of the Ocean.—The Tuesday evening discourse during the late meeting of the British Association was delivered by Mr. J. Murray, F.R.S., of the *Challenger* expedition, who took for his subject the "Bed of the ocean, and some results of the expedition." In commencing his lecture, Mr. Murray traced the development of geographical knowledge from the crude conception of the ancients down to the extended knowledge of the nineteenth century. It was not easy, he said, to estimate the relative importance of the events of one's own time, yet, in all probability, the historians of the reign of Victoria would point to the recent discoveries in the great oceans as the most important events of the century with respect to the acquisition of natural knowledge—as among the most brilliant conquests of man in his struggle with nature; and doubtless they would be able to trace the effects of these discoveries on the literature and on the philosophic conceptions of our age. The last of the great outlines showing the surface features of our globe had been boldly sketched; the foundations of a more complete and scientific physiography of the earth's

surface had been firmly laid down. The lecturer then briefly described the chief surface features of the globe, the action of wind and water and ocean currents; referred to the temperature of the surface of the sea, and explained that the most important, as well as the most direct, effect of the unequal distribution of temperature over the surfaces of the oceans and continents was an unequal distribution of atmospheric pressure, varying more or less with season. He then proceeded: The advances during recent years in the knowledge of one form of life inhabiting the floor of the ocean surpassed those in any other department of oceanic investigation. Thousands of new organisms had been discovered in all seas and at all depths in the ocean, and either had been or were now being described by specialists in all quarters of the world. There did not seem to be any part of the ocean bed so deep, so dark, so still, or where the pressure was so great as to have effectually raised a barrier to the invasion of life in some of its many forms. Even in the greater depths all the great divisions of the animal kingdom were represented. As they descended into the deeper waters, and proceeded further seaward from the borders of the continents, species and the number of individuals became fewer and fewer, though they often presented archaic or embryonic characters, till a minimum was reached in the greatest depths furthest from continental land. Distance from continental land was, indeed, a much more important factor in the distribution of deep-sea animals than actual depth. If they neglected the Protozoa and compared the results of twelve of the *Challenger's* trawlings and dredgings in the central line of the Pacific, in depths greater than 2000 fathoms, on globigerina ooze, radiolarian ooze, and red clay, with twelve trawlings and dredgings taken under similar conditions and depths, but on the blue and green muds within 200 miles of the continents, they found that the central Pacific stations yielded ninety-two specimens of animals belonging to fifty-two species, all—with two doubtful exceptions—new to science, and among them thirteen new genera. On the other hand, the stations near the continents gave over 1000 specimens, belonging to 211 species, of which 145 were new species and sixty-six belonged to species previously known from shallower water. Although no new types of structure had been discovered in organisms from the deep sea, the peculiar modifications which animals had undergone to accommodate themselves to abysmal conditions were sufficiently interesting and remarkable. The eyes of some fish and crustaceans had become atrophied or had disappeared altogether, while in others they had become of exceedingly large size, or been so modified as to be scarcely recognizable as eyes. Fins and antennæ had become extraordinarily elongated, and at times appeared to simulate the alcyonarians of the deep sea. The higher Crustacea and some families of fish had very few and very large eggs in the deep-sea species, while their

shallow-water representatives had a very large number of very small eggs; showing apparently that the deep-sea species had relatively few enemies. Many deep-sea animals emitted, and some had special organs for the emission of phosphorescent light, which appeared to play a large *rôle* in the economy of deep-sea life. One of the most striking facts with respect to deep-sea animals was their very wide distribution, the same species being found in all the great ocean basins. After referring to examinations of coral atolls and barren reefs, Mr. Murray said the results of many lines of investigation seemed to show that in the abysmal regions they had the most permanent areas of the earth's surface, and he was a bold man who still argued that in Tertiary times there was a large area of continental land in the Pacific, that there was once a Lemuria in the Indian ocean, or a continental Atlantis in the Atlantic. It mattered little whether the opinions which he had given as to the bearing of some of the researches be correct or not. The great point was that there had been a vast addition to human knowledge, and it must be a matter of satisfaction that our own country had taken so large a share in these important investigations as to call forth the admiration of scientific men of all countries. In the matter of deep-sea investigation, neglecting mere details, we could say that successive governments during the past twenty years had, either from design or by accident, undertaken a work in the highest interests of the race, had carried it on in no mean or narrow spirit, and were likely to carry it to a termination in a manner worthy of a great, free and prosperous people.

GEOLOGICAL NEWS.—*General.*—The third International Congress of Geologists has just been held in Berlin, 255 members being present, the majority Germans. Italy sent eighteen, Austria sixteen, Great Britain eleven, France ten, and the United States nine representatives. The most important work of the congress is the preparation of a geological map of Europe. It is expected that next year proofs in color of many of the sheets will be ready. The unification of geological nomenclature does not appear likely to be realized, but the congress has agreed that the Archæan rocks shall be divided into sections according to their petrographical characters, without expressing any opinion as to their relative age.

Jurassic.—At the recent meeting of the French Association, M. Cotteau stated that the Jurassic strata of France have furnished 125 species of Echini, belonging to fifty genera, two only of which, Cidaris and Stomechinus, subsist at the present day. The shallow seas of the Jurassic epoch, full of islands and coral reefs were favorable to the development of Echini.——M. Loriol has published, in the *Paléontologie francaise*, descriptions of 209 crinoids found in France. Of these eighty-nine were new to science;

while the Echini were most abundant in the Bajocian stage of the Jurassic, the crinoids attained their maximum in the Oxfordian. After the Sequanian they suddenly diminish, and only one species occurs in the Portlandian.

Quaternary.—At Ternefine near Maseara (Algeria) teeth of two species of Elephas (*E. atlanticus* and *E. melitensis*) have been found, also *Rhinocerus mauritanicus*, a hippopotamus and *Camelus thomasi*. The last is of about the size of the dromedary, but differs in the shape of the palate and jugal bones. With these were found a horse rather larger than the zebra, some antelopes, an ox, and a single bone of a swine. Roughly-shaped hatchets of limestone or coarse sandstone show the presence of man, but no remains of the domestic dog and no bones marked by the teeth of Carnivores were found. The presence of a large number of the cotyloid cavities of the pelvis of the elephant seem to indicate that they were used as utensils, and the numerous canines and incisors of the hippopotamus found were probably employed as weapons.

MINERALOGY AND PETROGRAPHY.[1]

AMERICAN MINERALS.—*Quartz.*—Vom Rath describes[2] quite a number of complicated forms on the quartz crystals from Alexander and Burke counties, N. C. The former have already been mentioned in these notes.[3] Among the rare forms on the latter are $-\frac{11}{18}$ R $\frac{11}{7}$, P_2 and a rough face to which the symbol oP may be referred.

Stephanite.—In the same article a stephanite crystal from Mexico, containing the new form $\frac{11}{8}$ P $\frac{11}{3}$ is described.

Alaskaite of König,[4] has been reëxamined by Th. Liweh, of Strassburg, who declares it to be tetrahedrite. He found it to crystallize in the hemihedral division of the regular system.

In the November number of the NATURALIST, fayalite was mentioned as having been found by Mr. J. P. Iddings in the lithophyses of the obsidian and rhyolite from the Yellowstone Park. About the same time C. A. Tenne,[5] of Berlin, found the same small black crystals in the lithophyses of obsidians from the Cerro de las Navajas, Mexico. They were measured and pronounced to be the same mineral which G. Rose, as early as 1827,[6] had declared to be olivine.

[1] Edited by W. S. BAYLEY, Johns Hopkins Univ., Baltimore, Md.

[2] Mineralogische Mittheilungen. Zeitschrift für Krystallographie, X, pp. 156 and 475.

[3] May, 1885.

[4] Ueber die alaskaite, ein neues Glied aus der Reihe der wismuthsulfosalze. Zeitschrift für Krystallographie, VI, p. 42.

[5] Zeitschrift der deutschen geol. Gesellschaft, 1885, p. 613.

[6] Annalen der Physik. u. Chemie, 1827, Bd. X, pp. 323–332.

Turquoise pseudomorphs after apatite have been discovered[1] in several localities in California with the original forms so well preserved as to leave no doubt as to the character of the mineral after which they are pseudomorphed. The angles between the ∞P faces gave, on the reflexion goniometer, a mean value of 59° 56′, that between oP and ∞P measured 89° 39′, and those between oP and P 40° 35¾′. (Kokscharon found on apatite from Tokovaia oP $\wedge$P = 40° 18′–40° 47′.) Professor H. Bücking examined thin sections of the specimens and found the substance to consist of an aggregate of small spherulites composed of fibers radially arranged.

Two *pure iron micas* from Branchville, Conn., have been added to the mica group by Rammelsberg.[2] One of a light color gave, on analysis:

SiO_2	Al_2O_3	Fe_2O_3	FeO	K_2O	Na_2O	Li_2O	H_2O	Fl
44.19	32.69	4.75	3.90	8.00	.59	.21	.3.85	.93

A dark-brown variety gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	K_2O	Na_2O	Li_2O	H_2O	Fl	TiO_2
39.94	23.43	7.65	11.87	9.64	1.13	1.18	2.64	2.43	.20

The composition of the first corresponds to $\left\{\begin{matrix} 6\,R_4'\,SiO_4 \\ Fe_2\,SiO_4 \\ 7\,R_2\,Si_3O_{12}\end{matrix}\right\}$; of the second to $\left\{\begin{matrix} 2\,R_4'\,SiO_4 \\ Fe_2\,SiO_4 \\ 2\,R_2\,Si_3O_{12}\end{matrix}\right\}$. In neither case was any Mg detected. Their optical properties were not investigated.

Microlite.—C. Hintze[3] has shown by optical methods that this mineral, first described by Dunnington[4] from Amelia county, Va., crystallizes in the regular system.

In a paper read before the American Philosophical Society, F. A. Genth[5] gives the results of the analyses of a number of minerals belonging to the sulpho-salts and allied groups. The mineral joséite, concerning whose composition there has been considerable doubt, yielded the author:

Te	Se	S	Bi
14.67 per cent	1.46 per cent	2.84 per cent	81.23 per cent

This composition, Genth thinks, cannot be expressed by a rational formula unless we suppose the mineral to be a bismuth sulphide in which the sulphur is replaced in part by tellurium, selenium and bismuth, giving the general formula both for joséite and the closely related tetradymite Bi_2 (Te Se S Bi)$_3$. An argento-bis-

[1] Kallait pseudomorph nach apatite aus California, G. E. Moore and V. von Zepharovich. Zeitschrift für Krystallographie x, p. 240.

[2] Neues Jahrb. für Min., etc., 1885, II, p. 225.

[3] Zeitschrift für Krystallographie, x, p. 86.

[4] *Amer. Chem. Jour.*, 3, p. 130, May, 1881.

[5] Contributions from the laboratory of the Univ. of Pennsylvania. No. XXIV. Contributions to mineralogy, read Oct. 2, 1885.

muthite, from Lake City, Col., gave results corresponding to $(Ag_2\ Pb)\ S,\ Bi_2\ S_3$. Cosalite is a sulpho-bismuthite of the formula $2\ (Pb\ Ag_2)\ S,\ Bi_2\ S_3$ from Cosala, Mexico. In the Gladiator mine, Ouray county, Col., a compact mineral occurs in small irregular masses. An analysis shows it to be cosalite with part of the silver replaced by Cu, having the formula $2\ (Pb\ Ag_2\ Cu_2)\ S,\ Bi_2\ S_3$. Schirmerite, beegerite, tetrahedrite, sylvanite and polybasite from Colorado, and arsenopyrite and scorodite from Alabama are the other sulphur salts examined. Ilmenite from Carter's mine, N. C., topaz from Stoneham, Me., muscovite pseudomorphs after nepheline from Wakefield, Conn., stilpnomelane pseudomorphs after "an unknown tabular mineral," from Sterling mine, near Antwerp, N. Y., and several alteration products of the magnesian limestone of Berks county, Pa., are also described and the results of their analyses given.

MICROCHEMICAL REACTIONS.—It is often possible by means of a few simple chemical tests to determine the character of a mineral under the microscope without the trouble of separating and analyzing it. The methods in most general use for this purpose are those of Streng[1] for the detection of apatite and nepheline, of Knop[2] for the minerals of the Hauyne group, of Boricky[3] for the feldspars and of Behrens[4] for the characteristic elements of many other minerals. These and a great many others have been described at length in the various mineralogical magazines, but have not, until very lately, been collected and put in shape for ready use. Dr. Haushofer, of Munich, has recently brought together all those methods which have stood the test of experience, and to these has added others of his own. The result is a compact little book[5] containing minute directions for the detection of fifty elements by means of simple tests, most of which may be applied to the rock section or mineral particle on the stage of the microscope. The illustrations are good and the directions for working clearly given.

CRYSTALLOGRAPHIC NEWS.— E. Rethwisch[6] has made a very thorough study of pyrargyrite and proustite from an historical,

[1] A. Streng. Ueber die mikroskopische Unterscheidung von nepheline and apatite. Tschermak's Min. und Pet. Mitth., 1876, p. 167.

[2] A. Knop. Ueber eine mikrochemische reaction auf die Glieder der Hauynfamilie. Neues Jahrb. der Min., etc., 1875, p. 74.

[3] E. Boricky. Elemente einer neuen chemisch-mikroskopischen Mineral- und Gesteins-analyse. Archiv. d. naturw. Landes durchforsch. Böhmens. III Bd., v Abth., Prag, 1877, and Neues Jahrb. f. Min., etc., 1879, p. 564.

[4] Th. H. Behrens. Mikrochemische Methoden zur Mineral-analyse. Verslagen en Mededeelingen der K. Akad. v. Wetenschappen. Amsterdam, 1881. Afdeeling Natuurkunde, 2 Reeks, XVII Deel., pp. 27–73.

[5] Mikroskopische Reactionen. Eine Anleitung zur Erkennung Verschiedener Elemente und Verbindungen unter dem Mikroskop. Vieweg und Sohn, 1885. 162 pp., 137 illus.

[6] Neues Jahrb. für Min., etc. Beilage Band IV, p. 40.

chemical and crystallographic standpoint. His paper is particularly interesting as a résumé of our knowledge in regard to these two minerals.——In the same way F. Sansoni proposes to study calcite. He begins his work with an exhaustive paper of fifty-six pages on the crystals from Andreasburg.[1] He divides these into eight groups, according to their development, and then studies each group separately. Tables giving the frequency with which the 131 forms actually observed occur, and the combinations in which they are found, make up a considerable part of the article.

MISCELLANEOUS.—A chemical examination of nocerite[2] from Samo-Nocera leads E. Fischer to consider it a mixed fluoride and oxide with the composition 2 (Ca Mg) Fl_2 + (Ca Mg) O.——In an article on the Thüringian minerals, Luedecke[3] describes crystals of orthite, from near Schmiedefeld, with the two new planes $5\,P\frac{-}{\infty}$ and $\infty\,P\frac{-}{10}$, others from a granitite near Brotterode with $\frac{7}{8}\,P\frac{-}{\infty}$, and tiny brown anatase crystals on small quartz crystals in the lithophyses of a quartz porphyry from Brand, Thüringer Wald.

BOTANY.[4]

THE ASA GRAY VASE.—During the meeting of the American Association for the Advancement of Science, at Ann Arbor, in August last, the presence of so many botanists, and especially their frequent club meetings, suggested to the editors of the *Botanical Gazette* the possibility of some concerted action on the part of the botanists of the country to commemorate Dr. Asa Gray's seventy-fifth birthday anniversary. After some informal consultation, the matter was left in the hands of the originators to be managed as they thought best. Accordingly, notices were sent to as many American botanists as it was possible to reach in the short time at the disposal of the committee. The responses were most gratifying, and enabled the committee to select a design of a vase by L. E. Jenks, of Boston. The vase is solid silver, eleven inches in height, and stands upon a silver-hooped ebony pedestal. The ornamentation is very properly entirely botanical, and consists of plants in some way associated with Dr. Gray's work, or which are distinctively American. In the center of one side is *Grayia polygaloides*, on the other *Shortia galacifolia*. The following species are represented in the surrounding figures, viz: *Adlumia cirrhosa, Rudbeckia speciosa, Centaurea americana, Aquilegia canadensis, Aster bigelovii, Solidago serotina, Notholæna grayi, Lilium grayi, Dionæa muscipula, Jeffersonia diphylla, Mitchella repens, Epigæa repens.* The beauty of design and finish, as

[1] Zeitschrift für Krystallographie, x, p. 545.
[2] Zeitschrift für Krystallographie, x, p. 271.
[3] Ib., x, p. 187.
[4] Edited by Professor CHARLES E. BESSEY, Lincoln, Nebraska.

well as the botanical accuracy of the work, have been much admired. Upon the hoop of the pedestal the following legend is engraved:

1810—November eighteenth—1885.
ASA GRAY,
In token of the universal esteem of American botanists.

The vase, accompanied with the cards of one hundred and eighty botanists, was presented without formality on Wednesday morning, the 18th of November.

It is a very pleasant duty to record in the NATURALIST the consummation of such a fitting plan of showing the esteem in which the name of Asa Gray is held by the botanists of America. That the days of the genial doctor among us may be prolonged for many years is the fervent prayer of every botanist.

CATALOGUE OF THE PLANTS OF NORTH AMERICA.—Every botanist who has charge of a considerable collection of plants has felt the need of a convenient check-list of North American plants. The old Gray Catalogue, which was followed by the Mann Catalogue, both confined to the plants included in Gray's Manual, and later, the more extended list compiled by A. H. Curtiss, served a good purpose. These, however, included a comparatively small part of the species of the whole continent, and the botanist who added Western species to his collection was left without the means for noting his accessions. This want is now supplied (in part, at least) by the Catalogue of the Phænogamous and Vascular Cryptogamous plants of North America (north of Mexico) compiled by J. H. Oyster, of Paola, Kansas. It contains entries of 9867 species. The arrangement of Choripetalæ and Gamopetalæ conforms very nearly with that of Bentham and Hooker's Genera Plantarum. For some unexplained reason the arrangement of Apetalæ and the Monocotyledons is not that of the Genera Plantarum, an unfortunate feature which might easily have been avoided. The species of each genus are arranged alphabetically, as is proper in a check-list. The proof-reading has been carelessly done, and the printing is not of the best; yet, with all its faults, the pamphlet is worth the price charged for it ($1.00), and will serve a good purpose.

THE DE CANDOLLE PRIZE.—The Physical and Natural History Society of Geneva offers a prize of five hundred francs for the best monograph of a genus or family of plants. The manuscript may be written in Latin, French, German, English or Italian, and should be sent to M. le President de la Société de Physique et d'Histoire Naturelle de Genève, a l'Athenée, Genève, Switzerland. —*Gardner's Chronicle.*

THE DRYING OF WHEAT.—Experiments were made in 1884 at the New York Agricultural Experiment Station upon the loss of water by wheat in drying. In the first case Clawson wheat, har-

vested July 16 and threshed July 18, contained 27.02 per cent of water, of which there were lost by evaporation the following percentages, viz:

July 27	loss 13.80 per cent.	Sept. 14	loss 20.33 per cent.
Aug. 3	" 17.33 " "	" 21	" 20.39 " "
" 10	" 18.59 " "	" 28	" 19.54 " "
" 17	" 19.58 " "	Oct. 5	" 18.97 " "
" 24	" 20.62 " "	" 12	" 19.48 " "
" 31	" 19.97 " "	Nov. 22	" 24.06 " "

In the second case samples were taken from the bin on September 4, with the following results, viz:

Sept. 14	loss 2.77 per cent.	Oct. 5	loss 1.57 per cent.
" 21	" 3.12 " "	" 12	" 2.18 " "
" 28	" 2.15 " "	Nov. 22	" 8.12 " "

In both cases the samples were exposed to the natural air of the laboratory until October 12, after that date, to November 22, the air was warmed by steam pipes.

The amount of water in wheat in the bin taken at different dates, from the interior of a mass of several hundred bushels, was as follows, viz:

September	22	11.96 per cent of water.
October	13	16.57 " " "
"	23	14.62 " " "
Noyember	1	14.17 " " "
"	12	14.87 " " "

THE STUDY OF PLANTS IN WINTER.—The old-fashioned text-books tell us to begin the study of plants in the spring, and the custom still in most colleges is to confine the study to the spring and early autumn months. Winter usually stops all work except in the laboratories when "pickled" specimens are dried and examined microscopically. Perhaps in a few cases the green-house may supply unseasonable specimens for class or laboratory study; but this is not the study of plants in winter that we refer to. All our perennials have winter states which are full of interest to the student. The writer of this note has taken classes of young people, who knew nothing of botany, and set them at work in mid-winter studying the out-of-door vegetation, with nothing but their eyes, pocket-knives, pencils and note-books in the way of apparatus and helps. The structure, position and functions of buds, the structure of twigs and branches, including wood, bark and pith, the structure of the fruits and seeds, of various trees and shrubs, were taken up in succession, with constantly increasing interest. No text-book was used, the pupil depending upon his own resources entirely. By the time that spring came with its bursting buds, its leaves and its flowers, these trained young eyes were eager for their study.

THE BOTANICAL VALUE OF AGRICULTURAL EXPERIMENTS.—That many of the so-called agricultural experiments should have a

high botanical value is evident to every scientific man, but it is a melancholy fact, which does not speak well for the accuracy of the experimenters, that very little of their work has been of use in scientific botany. In the experiments recorded in the third annual report of the New York Agricultural Experiment Station, we have a notable exception to the rule. Many of the results obtained have a high value to the physiological and pathological botanist. Thus we find such topics as the following, viz: The hygroscopic properties of grains; Hybrid barley; Germinations of commercial seeds; The cross-fertilization of maize; A classification of maize, with a description of the species and varieties (with plates); A classification of the agricultural species of garden peas; The size and distribution of roots of various plants determined by washing away the soil; A classification of barley and oats; Report of the botanist upon diseases of the pear, apple, quince, peach, tomato, oats, clematis and Canada thistle. Topics like these, treated as these are, command the respect of scientific men. We hope to see the time when such will be the rule, and not as now the exception.

We hold that every agricultural experiment which has to do with plants must be sufficiently accurate to commend itself to the scientific man, in order that it may be of any permanent value to agriculture. Such an experiment which has no botanical value cannot have a permanent agricultural value. The demands of scientific botany are in no wise more exacting than those of scientific agriculture.

FERTILIZATION OF TEUCRIUM CANADENSE.—Of interest to American botanists is the proterandry of the American germander, simulating that of *T. scorodonia* of Europe. The corolla here is not bilabiate as usual in this family, but the tube is split open above as far as the calyx and the five lobes are arranged on one —lower—lip. In the bud the lowest or middle lobe turns up over the stamens and style, serving as a protection to them. This lobe is embraced by the two lobes on either side, and these in turn by the two upper lobes, which usually form the upper lip in the Labiatæ. In their first state, as in almost all flowers of this family, the stamens are curved forwards so as to come into more ready contact with the body of the entering insect, in this case usually a bee. The stigma is bent forwards like the stamens, but the stigma lobes having not yet opened, cannot be fertilized. Later the stamens bend far backwards, and since there is no upper lip to check this motion they actually recurve at times. The style in the meantime retains its position or takes a slightly higher position, while its stigma lobes open. The stamens themselves may be short and these are usually of almost equal length, or one or more of them may continue growth and even equal the style in length. There is no regularity, how-

ever, in their unequal development, but if the visits of bees should become less frequent, this variation would offer a means of self-fertilization, and would soon become fixed in all individuals of the species. The proterandry in this species is not perfect. The stigmas sometimes mature, I might almost say, precociously, and the stamens in turn often contain good pollen when the stigma lobes open. Again, the visits of bees seem to be less frequent in this part of the country than is usual with cross-fertilized Labiatæ, so I suspect that even the casual irregular growth of the stamens, is in some way correllated with this fact.—*Aug. F. Foerste, Granville, Ohio.*

SPECIMENS OF CUSCUTA WANTED.—Dried or alcoholic specimens of various species of Cuscuta are wanted by the subscriber. Any one having good specimens in flower or fruit for sale or exchange will confer a favor by communicating with Charles E. Bessey, Lincoln, Neb.

BOTANICAL NEWS.—Among the topics discussed at the International Congress of Botany and Horticulture, held at Antwerp (Belgium), August 1 to 10, were the following, viz: The rôle of the laboratory in modern science; Instruction in cryptogamic botany; Instruction in vegetable pathology; On the monographing of large genera; The rôle and organization of botanical laboratories; Labeling in botanic gardens, public parks, private gardens and conservatories; The progress of botany (mainly in the schools) since the Congress of 1878; Instruction in vegetable physiology. The papers are published in a thick pamphlet of over 400 pages.——The September Journal of the Linnean Society contains: Supplementary notes on Restiaceæ, by Dr. M. T. Masters; Observations on continuity of protoplasm, by S. Le M. Moore; On Rosanoff's crystals in the endosperm-cells of *Manihot glaziovii*, by S. Le M. Moore; On venation and the methods of development of foliage as protection against radiation, by Geo. Henslow.——E. A. Rau contributes a short list of Kansas mosses to the fourth bulletin of the Washburn College Laboratory of Natural History.——Bertrand continues his paper on Phylloglossum in late numbers of *Archives Botaniques du Nord de la France.*——The thirty-eighth report of the New York State Museum of Natural History appears much earlier than usual, greatly to its advantage and usefulness. The report of the botanist contains descriptions of many species of fungi. The New York species of Lactarius and Pluteus are arranged and described. Every botanist will welcome the early appearance of this report. May the vexatious delays of former years not occur again.——Limpricht's Laubmoose (mosses), which will constitute Vol. IV of the new edition of Rabenhorst's Kryptogamenflora, is announced by the publisher, Ed. Kummer, of Leipsig.——Dr. Havard's report on the flora of Western and Southern Texas, in the Pro-

ceedings of the U. S. National Museum, is a valuable contribution to our knowledge of the flora of the Southwest.——In a twenty-four page pamphlet, reprinted from Studies in the Biological Laboratory of the Johns Hopkins University, Dr. William Trelease records his observations on several Zoöglœæ and related forms. The following new species are described and figured, viz: *Bacterium candidum, B. aurantiacum, B. luteum, B. chlorinum, B. incarnatum.* A valuable feature of the work recorded is its biological character. One lays down the pamphlet with the feeling that much work can be done upon the basis of Dr. Trelease's observations. This record is an incentive to further study.—— Dr. Trelease's inaugural address, delivered upon his accession to the directorship of the Henry Shaw School of Botany, in St. Louis, November 6, is an admirable presentation of the claims of botany to a place in general education.——The January *Botanical Gazette* will contain a portrait and biographical sketch of Dr. Asa Gray, together with some of the poems, congratulatory addresses, etc., which were sent on his birthday, November 18, 1885.

ENTOMOLOGY.

Recent Discovery of Carboniferous Insects.—A rich deposit of Carboniferous insects has been discovered at Commentry, in the department of Allier, France, and has been worked up by C. Brongniart, whose work, however, has not yet been received. From a notice of his paper in the *Entomologische Nachrichten* for November last, we learn that over 1300 specimens of insect remains, not wings alone but also the bodies, have been preserved to science.

While an exclusive study of the shape and venation of the wings must necessarily have led to many errors, the discoveries at Commentry show that insects which are regarded as among the most ancient are still surprisingly like those of the present time, and only differ in comparatively unimportant respects.

In the oldest strata, the Silurian, has been found but a single winged insect, the still very problematical *Palæoblattina douvillei* Brong.; in the Devonian only the six species of insects, as to whose relations excellent naturalists, such as S. H. Scudder and H. Hagen, have very different views, and relative to which discussion has not yet closed. Before the present discovery only 120 specimens of Palæozoic insects were known.

From the Carboniferous formation of Commentry Brongniart has obtained over 1300 examples. Among them occurs the first fossil Thysanuran, represented by forty-five specimens. It differs from existing forms only by having a single caudal filament, and exclusive of this is 15 to 22$^{mm.}$ long, and is generally similar to Machilis; it is named *Dasyleptus lucasi.* Numerous representatives of our recent Acridians are brought together under the

name of Palæacridiodea, and divided into three groups with seven, mostly new, genera.

The types so discovered belong to the three orders of Orthoptera, Neuroptera, and Hemiptera, also to the Heterometabola of Packard and of Scudder, while the Metabola are still entirely wanting. But of the Heterometabola the Coleoptera are entirely wanting.

Between the Orthoptera and Neuroptera is placed the new order of Neurorthoptera, with the sub-order of Neurorthoptera in a special sense, and the Palæodictyoptera of Goldenburg; the first of these suborders embraces two families, the progenitors of the recent Phasmidæ, the Protophasmida, with genera containing the colossal forms: Protophasma, Lithophasma, Titanophasma and Archegogryllus, and the Stenaropterida with three genera.

To the Palæodictyoptera belong the Stenodictyoptera with the genera Eugereon Gold., Haplophlebium Scudd., Goldenbergia Scudd., Dictyoneura Gold., and two new genera wholly without recent representatives; in addition, the Termes-like Hadrobrachypoda, with Miamia Scudd., and the new genus Leptoneura, besides the wholly extinct Platypterida provided on the end of the abdomen with two filaments, which belong to the three genera, Lamproptilia, Zeilleria and Spilatera.

In the Pseudoneuroptera Brongniart places the wholly extinct family of Megasecopterida, with eight new genera whose relatives in part bore respiratory appendages on the abdomen, a group to which also belongs de Borre's much-discussed *Breyeria borinensis*. Also a family of Protodonata, regarded as the forerunners of the recent Libellulidæ, with Protagrion n. g. Likewise, thirdly, the family of Homothetida Scudder; also, new families, the forerunners of the recent ones, viz: the Protephemerina, Protoperlida and Protomyrmeleonida.

Of the Hemiptera five different genera belonging to the Homoptera have been found, among which belongs, in Brongniart's opinion, *Phthanocoris occidentalis*, erroneously regarded by Scudder as a Heteropteron.

Plateau's Experiments on Vision in Insects.—The question whether insects can distinguish the form of objects is asked by Professor Plateau in a communication to the Royal Academy of Belgium. He rejects the mosaic theory of vision proposed by Müller, following Exner in his essay on the perception of movements, and on the theory of compound eyes, presented to the Vienna Academy in 1875.

The work of Exner, says Plateau, leads to the theoretical deduction that insects and other Arthropods possessing compound eyes do not distinguish the form of objects. Exner supposes that, in the Articulates and in many other animals, vision operates in a different way from that generally admitted, and

consists mainly in the perception of movements. He enumerates, in support of his thesis, a series of important facts. In man the power of plainly distinguishing forms only belongs to the central part of the retina, while we perceive movements very well by the aid of the peripheral region of this sensitive layer.

Most animals, both vertebrates and invertebrates, seem but little impressed by the form of their enemies or of their victims, but their attention is immediately excited by the slightest displacement. Hunters, fishermen and entomologists have made in this respect numerous and demonstrative observations.

Finally, though the production of an image in the facetted eye of the insect or the crustacean seems impossible, we can easily conceive how the Arthropod can ascertain the existence of a movement. Indeed, if a luminous object is placed before a compound eye, it will illuminate a whole group of simple eyes or facets; moreover the centre of this group will be clearer than the rest. Every movement of the luminous body will displace the center of clearness; some of the facets not illuminated will first receive the light, and others will reënter into the shade; some nervous terminations will be excited anew, while those which were so formerly will cease to be.

In résumé, careful physiologists, relying on the structure of the compound eyes of Arthropods, admit that these animals do not see the form of objects, but only perceive colors and movements. Their facetted eyes are not complete visual organs, but simple organs of orientation.

Plateau then details the experiments he made to determine this question; and which we cannot well abstract. He calls attention to one result of his experiments: that insects only utilize their eyes to choose between a *white* luminous orifice in a dark chamber, or another orifice, or group of orifices, *equally white*. They are guided neither by odorous emanations, nor by differences of color. A fact which will certainly astonish all entomologists and likewise surprise the experimenter himself is, that bees have as bad sight and comport themselves almost exactly as flies.

From numerous experiments on Diptera, Hymenoptera, Lepidoptera, Odonata and Coleoptera, Plateau comes provisionally to the following conclusions:

1. Diurnal insects have need of a quick, strong light, and cannot direct their movements in partial obscurity.

2. In diurnal insects with compound eyes, the simple eyes offer so little utility that it is right to consider them as rudimentary organs.

3. Insects with compound eyes do not notice differences of form existing between two light orifices, and are deceived by an excess of luminous intensity as well as by the apparent excess of surface. In short, they do not distinguish the form of objects, or, if they do, distinguish them very badly.

THE DIVISION OF THE SEXES OF HYMENOPTERA.—We translate in a rather clumsy way Fabre's interesting article on this subject, published in the *Annales des Sciences Naturelles* (Tome XVII, Nos. 5 and 6). The entire article should be read to understand the subject.

The Osmias, the Chalicodomas and, as the closest analogies show, a great number of other honey-making Hymenoptera, arrange their egg-laying in female at first and then in male cells, when the two sexes have a different size and require unequal quantities of nourishment. If there is an equality of size between the two sexes, the same succession may exist, but less constantly.

This binary arrangement disappears when the place chosen for the nest is not large enough for the entire egg-laying. Then partial egg-layings occur, composed both of females and of males, and in harmony, as to their number and distribution, with the disengaged space.

To be able to give to each larva the room and the nourishment which it needs according to whether it is male or female, the mother decides the sex of the egg she is about to lay. According to the conditions of the home, often the work of another or a natural habitation slightly or not at all modifiable, she lays at her will either a male or a female egg. The division of the sexes is subject to her will.

The same prerogative belongs to the carnivorous Hymenoptera, the sexes of which have a different shape, and therefore need one more, the other less food. The mother must know the sex of the egg she is about to lay; she must dispose of the sex of this egg so that each larva shall obtain the right amount of food.

In a general way, when the sexes are of different size, every insect which collects the living prey, which prepares or at least chooses an abode for its offspring, must decide the sex of the egg to satisfy without error the conditions imposed upon it.

It remains to tell how this elective determination of the sexes is made. I do not absolutely know, I have never understood this delicate problem but attribute it to some fortunate circumstance which it is necessary to know or rather to watch for.

ENTOMOLOGICAL NEWS.—From a series of experiments by Professor Graber, says *Nature*, Oct. 22, relating to the effects of odorous matters on invertebrate animals, it appears probable that in the case of many insects neither the antennæ nor the palpi can be absolutely pronounced the most sensitive organ of smell, inasmuch as the one organ is most sensitive to some odorous matters, and the other for others.——Apropos of Hickson's account of the structure of the eyes of insects in our last number, we may say that, in 1883, B. T. Lowne published a paper in the Proc. Roy. Soc. London, of which an abstract has been published by Dr. Mack in *Psyche*, as follows: The author claims four forms

of eyes: simple ocellus, compound ocellus (larval insects), aggregate (Isopoda) and compound eye. A brief description of each is given. Discarding all previous theories of vision by compound eyes, it is held that "a continuous picture, a mosaic of erect magnified central portions of the several subcorneal images, falls upon the retina."——Kraepelin (Ueber die geruchsorgane der Gliederthiere), Osterprogram der Realschule des Johanneums, Hamburg, 1883, gives an historical sketch of the olfactory organs of Arthropods, followed by a bibliographic list (59 numbers) grouped according to the languages in which the articles were written. He criticises the results of others, and compares them with his own observations on several crustacea, beetles, chrysopa, Orthoptera, butterflies, flies and Hymenoptera (*Psyche*, 296).——In the Annales des Sciences Naturelles (XVII, Nos. 5 et 6) is an interesting article by J. H. Fabre on the division of the sexes in the Hymenoptera; it gives the results of many years observations on the subject which we refer to more at length elsewhere.——The Transactions of the American Entomological Society (XII, No. 2) contain several papers by Dr. Horn, viz: Descriptions of new North American Scarabaeidæ; Contributions to the Coleopterology of the United States; Descriptions of new Cerambycidæ, with notes; Synopsis of the Throscidæ of the United States; while Mr. F. Blanchard discusses the species of Canthon and Phanæus of the United States, adding notes on other genera; and Mr. W. H. Ashmead remarks on the cynipidous galls of Florida, giving descriptions of new species.

ZOOLOGY.

LIVING AND DEAD PROTOPLASM.—Dr. Oscar Loew read an important paper before the British Association on a chemical difference between living and dead protoplasm. Protoplasm, it was found, contains certain aldehyde groups, which account for the extreme mobility and readiness of change in living protoplasm. These aldehyde groups can be reduced by alkaline silver solution. Spirogyra, one of the lower algæ, acts on this solution in a peculiar way. Living protoplasm reduces the salt, while dead protoplasm does not. The specific gravity of the protoplasm of Spyrogyra was increased, and was found to contain silver deposited in its interior. Argyria, or the effect of nitrate of silver on the human subject in certain diseases, was found in these algæ. Thus was shown a specific chemical difference between living and dead protoplasm. Ordinary poisons, such as prussic acid and strychnine, seem to have no particular effect on lower organisms, while the poison irresistible by all protoplasm is hydroxylamyl. Professor Burdon-Sanderson said that this investigation had more importance than might at first appear, for it had arisen out of the epoch-making paper of Pflüger. Pflüger concluded that there must be a chemical change in the transition from living to dead

protoplasm, and Dr. Loew took up the question as to what exactly this change was. His investigations are an important step in deciding this important question. Professor Stirling said this gave a new test for living protoplasm. The chief thing to settle was what exactly causes reduction of the silver.

SPHÆRULARIA IN AMERICA.—In 1836 Léon Dufour described (Annales des Sciences Naturelles, ser. 2, v. 7, p. 9), a peculiar vermiform parasite, which he found in *Bombus terrestris* and *B. hortorum*, to which he gave the name of *Sphærularia bombi*, placing his new genus among the entozoa. In noting the occurrence of this genus of parasites in America, it may not be out of place to give some further account of it because of its unique structure and metamorphoses, and to enable its easy recognition.

Dufour's description reads: "Teres, albido-pellucida, mollis, filiformis, haud annulata, undique sphærulis vesiculæ formibus granulata, antero posticeque obtusa subrotundata." He adds in the French notes which accompany the above description that the length is 6–8 lines, that it is not very slim since it is about a line in diameter, that it shows no distinction of head or tail, being obtuse or rounded at both ends, and that all the surface, both above and below, is covered with spheroidal granulations which are like subdiaphanous vesicles.

Von Siebold, in 1838, wrote of this worm, and mentioned finding its young in bees, and that the young differed greatly from the supposed adult in having smooth skin. From the active young he saw that the worm belonged to the nematoids, but in the supposed adults, which were all females, he could discover no motion. He further notices that its digestive apparatus differs from that of all nematoids.

Siebold and Stannius write, "One finds neither mouth nor anus in *Sphærularia bombi*, and the intestinal canal is replaced by a series of elongated cells, adhering together, and around which the genital organs are entwined."

The next naturalist to investigate this curious animal was Lubbock, who published, in 1861, in the *Natural History Review*, a paper "On *Sphærularia bombi*," illustrated by a plate. Lubbock discovered at one end of the body which Dufour had described a minute nematoid worm, and wrongly thought this minute worm to be the male in copulation with the large body which was the female. In describing the so-called male, he is careful to state that he had not been able to distinguish any generative organs or any trace of spermatozoa, and discusses the possibility of the appended worm being a parasite of Sphærularia, or even its larval skin. Lubbock, whose article is very interesting, describes the anatomy of the so-called female, and states that it has "no muscles, no nervous or circulatory systems, and no intestinal canal," and that "the interior of the body is wholly occupied by

two relatively enormous organs—the double series of secretory cells, and the ovary." The double series of cells he terms the *corpus adiposum*, and homologizes it with the intestine of other nematoids. Lubbock mentions briefly the prolificacy of Sphærularia, and the mode of development of its eggs. He discovered that the parasite was only present in large females of Bombus, but he was unable to trace its metamorphosis, and to discover how the bees were infected.

In a later paper Lubbock gives a brief account of his further studies on Sphærularia. He succeeded in keeping the young alive several weeks in water, and suggests that the young pass from moist earth into the bees while the latter are going about in moss and damp grass. He found half-grown females of Sphærularia, but still always with the so-called male attached, and he calls attention to the peculiar cell-structure of the so-called females.

Schneider was led by the cell-structure of the so-called females, and by the organic union between them and the little worm at their end, a union at a point where the sexual opening should be, to express the opinion that the so-called female was the evaginated and full-grown ovary of the little worm to which it was attached. Schneider's opinion, derived from structure, awaited proof based on observation, and this has at last been furnished by Leuckart.

Leuckart, in a preliminary communication in the *Zoologischer Anzeiger* of this year traces the evagination of the genital organs of the female to form the appendage which was so long regarded to be the female itself, the subsequent growth of the appendage, and the origin and homological significance of its parts. This worm-like body may even lose the minute female from which it was originally an evagination even before its eggs are ripe.

Lubbock, in the paper already mentioned, and Linstow, in his "Compendium der Helminthologie," enumerate the species of Bombus in which *Sphærularia bombi* has been found; the former author gives their relative abundance in different species of bees, and states that the number of Sphæruläriæ usually present in a single bee is from four to eight, but in one specimen he obtained no less than thirty-four, the greater number of which were full-grown. In some European species of Bombus one-half the large females which have hibernated contain these parasites in May and June.

Wishing to see if Sphærularia was to be found in America, I examined ten specimens of Bombus taken on the 10th of June last, in Cambridge, Mass. The species of Bombus were not determined. Only two of the specimens were parasitized; in one was a single Sphærularia, in the other were two. The Sphærularia found single was 2.9 centimeters in length; each of the other specimens was a trifle shorter. Nothing seemed to indi-

cate that the specimens found in the American bees were other than *Sphærularia bombi*, except that they were a trifle larger than the size usually given for that species. Dufour states the length of *S. bombi* to be from "6–8 lin.," Lubbock "nearly one inch," and Leuckart "1.5 cm." Further examination of females of determined species of bees, at the time when they come from their winter retreat, and more specimens are necessary to know whether Sphærularia is as abundant here as it is in Europe, and whether the species is the same.—*George Dimmock.*

NOTES ON SOME EASTERN IOWA SNAILS.—During the past season I have taken several interesting species new to the vicinity of Davenport, Ia. Among them the *Gundlachia meekiana* Stimp., a shell not before reported from the West. The specimens are decidedly larger than Stimpson's types, and extremely variable—some of them agreeing exactly with the description and figures of the *G. stimsoniana* Smith and Prime, and plainly indicating the specific identity of the two forms. As Stimpson writes, the septum in the aperture of Gundlachia seems to be formed at the end of the first season's growth; but numbers of *these* limpets formed no plate, simply adding the second season's growth on the margin of former peristome, thus making a real *Ancylus* with black conical cap. Lily pads seem to be their favorite station. Each limpet eating an irregular area on the under side, but never perforating the leaf.

Numerous specimens of the *Fyrgula scalariformis* Wolf, unnoticed since the publication of the original description nearly twenty years ago, were found near the mouth of Rock river, a few miles below Davenport. The validity of this species has recently been questioned by Mr. R. E. Call, who refers it to *Pomatiopsis lapidaria* Say! The specimens taken leave no doubt concerning the position of these tiny snails in the genus Pyrgula—unless the anatomy show greater divergence from that type than the shell. Our Rock river specimens are smaller, stouter than typical fossil *scalariformis*, and more compactly coiled—never exhibiting the peripheral carina on upper whorls. The shorter forms remind one of the common rhomboidal variety of *Anculosa dissimilis* Say. These have been distributed by the writer to correspondents under the varietal name of *P. scalariformis mississippiensis.*

Observations on Mississippi river Lioplax tend to confirm the opinion of the late Jas. Lewis, that the eastern and western Lioplaces are especially distinct. The foot in our specimens only slightly exceeds the shell in length, while Binney's figures (of the eastern form) represent it nearly double the length of shell.

My measurements were taken while the animal was in rapid motion—its greatest length being then attained.—*Harry A. Pilsbry.*

THE BATRACHIAN INTERCENTRUM.—The determination of the homologies of the segments of the vertebral centra of the rhachitomous and embolomerous batrachians is a question of importance in the history of the evolution of the three classes of land Vertebrata, the Batrachia, the Reptilia and the Mammalia. I have already made such determinations, but Professor Gaudry subsequently made different ones, and in this he is followed by the European palæontologists, especially by Fritsch in his Fauna der Gaskohle der Permformation Bœhmens. I have reëxamined this question, and with the aid of new material I am able to reach further definite conclusions in the matter.

The facts which I have discovered are the following:

I. In the Pelycosauria the chevron bones form a continuum with the intercentrum[1] (hypocentrum Gaudry).

II. In the caudal vertebræ of Eryops also (Rhachitomi), the chevron bones form a continuum with the intercentrum.[2] I therefore believe the intercentra of Clepsydrops and of Eryops to be homologous parts.

III. In the caudal series of Cricotus[3] (Embolomeri) the intercentra are as large as the centra, and except that they form a continuum with the chevron bones, resemble them, and take part with them in supporting the neural arch.

IV. In the dorsal region of Cricotus the neural arch loses its articulation with the intercentrum and stands exclusively on the centrum.[4] The serial homologies of the centra and intercentra are readily traceable in this genus throughout the column.

In spite of these facts Dr. Fritsch and others regard the intercentrum of the Rhachitomi (hypocentrum of Gaudry) as the true centrum. His reasons for this course are the following:

I. In the caudal region of Sparagmites and Diplovertebron the neural arch stands on the intercentrum,[5] so that it is easily mistaken for a centrum.

II. In the dorsal region in Chelydosaurus and Sphenosaurus, the neural arch stands above or on the intercentrum, while the centrum (pleurocentrum and hypocentrum pleurale) is reduced in dimensions.

III. It thus results that the small hypocentrum pleurale resembles the intercentrum of the Reptilia and certain Mammalia, rather than the centrum, to which it truly belongs.

I am of the opinion that the homological determinations of Gaudry and Fritsch, in this matter, are erroneous, and for the following reasons:

I. The neural arch being free may change its articulation from

[1] Proceedings Amer. Philosoph. Soc., 1878, p. 510.

[2] Loc. cit., 1880. Pal. Bulletin, No. 32, p. 15, Pl. III. fig. 5.

[3] Loc. cit., 1878, p. 522.

[4] Loc. cit., 1878 522, and 1884, p. 29. Dr. Fritsch has overlooked these references, and wrongly believes that the complete intercentra of Cricotus are confined to the caudal region.

[5] Fauna der Gaskohle, Bd. II, Heft 1, Pl. 50, fig. 14, 15–16.

centrum to intercentrum and *vice versa*, while the chevron bones being continua, cannot do so.

II. The neural arch actually does shift its position in Cricotus. In the posterior part of the caudal series it is principally on the intercentrum; in the dorsal region it is on the centrum.

From the preceding considerations I get the following important results:

I. The principal vertebral bodies in the Sphenosauridæ[1] (Sphenosaurus and Chelydosaurus), if Fritsch's descriptions be correct, are intercentra and not centra.

II. It is probable that the true centra become extinct in the batrachian descendants of this family, so that the solid vertebræ of such Batrachia are intercentra, and not centra.

III. The characters of Cricotus on the other hand point to the extinction or reduction of the intercentra as we find it in the pelycosaurian Reptilia, and point to the probability of the Embolomeri being ancestors of the Reptilia, as I have already suggested.[2]

IV. The Sphenosauridæ (which must also include Sparagmites) are intermediate between the Rhachitomi and the Embolomeri, resembling rather the latter in the completion of the true centrum, but resembling the former in the incompleteness of the intercentrum.

I note here that Dr. Credner[3] does not understand why I should have overlooked the discovery of the rhachitomous structure of Archegosaurus by Von Meyer forty years ago. I think any one who examines Von Meyer's description and figures will find ample reason why one should not see the rhachitomous structure in them, without overstepping the bounds of scientific caution. And it is evident that European naturalists did not recognize this structure, as they make no mention of it during those forty years, although specimens of Archegosaurus are abundant; but rather frequently referred Archegosaurus to the Labyrinthodontia, which are described as having the vertebræ undivided.

I had hoped to have given before now engravings in quarto of these important forms, but the present U. S. Geological Survey having suspended my work, I am unable to do so.—*E. D. Cope.*

EMBRYOLOGY.[4]

THE DEVELOPMENT OF THE TOAD-FISH.—The development of the Batrachidæ is not well known, as will appear from some of the statements in systemetic treatises. One author states that: "The young of some or all the species fasten themselves to rocks by means of an adhesive disk, which soon disappears."

It is the purpose of this notice to point out that the adhesive disk referred to above is of a wholly different nature and origin from that found in the lump-fishes and Gobiesocidæ in which such

[1] Cope. NATURALIST, 1885, p. 592.
[2] AMERICAN NATURALIST., 1884, p. 37.
[3] Die Stegocephalen aus dem Plauenschen Grundes bei Dresden; Zeitschr. Deutsches Geol. Gessellsch., Berlin, 1885, p. 721.
[4] Edited by JOHN A. RYDER, Smithsonian Insti tution, Washington, D. C.

a disk is formed by the confluence or coalescence of the pectoral pair of fins.

The adult toad-fish burrows a cavity under one side of a submerged boulder, and to the solid roof of this cavity the female attaches her ova in a single layer. The eggs are very adhesive and quite large, measuring about one-fifth of an inch in diameter. Like the male cat-fish, the male toad-fish assumes charge of the adherent brood of eggs and remains by them until they are hatched and subsequently become free.

The egg-membrane or zona radiata is very firm, and adheres to the under surface of the stone by a discoidal area about 3^{mm} in diameter. The free globular pole of the egg is accordingly directed downwards. The germinal disk is developed at the lower pole and gradually spreads so as to enclose the vitellus from below upwards. The result is that the embryo is formed upon the lower or free pole of the egg, where it develops until it finally ruptures the egg membrane, when it may be said to have hatched, but, unlike all other types of fish-embryos known to me, the young fish does not at once drop out of the egg-membrane when the latter is ruptured. This is prevented by the adhesion of the ventral (now upper) pole of the yolk-sack to the inside of the egg-membrane just before the latter is ruptured. Just how this secondary adhesion of the yolk-sack is effected has not been determined, but the adhesion persists until the embryos are considerably over one-half inch in length.

In the course of the development of other parts, the yolk-sack is finally constricted horizontally round the middle below the body of the embryo, and becomes hour-glass-shape. This is due in part to the down growth of the mesoblastic somites on either side of the yolk from above; as a result of this a part of the yolk becomes intra-abdominal while a part of it remains for a time in the lower bulb of the yolk-sack and outside of the true abdominal cavity. Eventually the whole of the yolk becomes intra-abdominal; this is due in part to its further absorption and the further development of the abdominal walls of the embryo, but during all of this time, or until yolk-absorption is completed, the embryo remains adherent as described above. At this stage the embryo is so far developed that it would be recognizable as belonging to the genus Batrachus.

The pectoral and pelvic fins develop as very short folds which are close together, the latter arising almost immediately behind the former. In the course of further development, the pelvic fins are suddenly translocated forwards in advance of the pectorals, and are finally brought to lie near the constriction in the yolk-sack and just above the lower bulbous portion of the latter. It will therefore be obvious to any one that neither the pectoral nor pelvic fins have anything to do with causing the adhesion of the embryos, for both of these fins arise far above the point where the young fish is adherent.

The paired spinal nerves which pass to the pelvic fins are caused to cross those passing to the pectorals, because of the sudden translocation of the former pair of fins already alluded to.

It has also been stated by authors that Batrachus possesses no lateral line. This is an error, for the writer found that the neuromastic grooves or furrows, which remain open for a considerable time on the heads of the larvæ, are continued into a lateral line system on the sides, a condition of things which is also very evident in the adult, if the latter is carefully examined. There are also series of efferent pores present in the adults. The lateral neuromastic canal bifurcates in the vicinity of the shoulder-girdle and sends a dorsal branch backward below the base of the dorsal, and a ventral branch above the base of the anal. These two canals run nearly parallel along either side of the body and even extend backward upon the tail, as shown by some fine preparations of the skin of the embyro mounted by Professor Libbey, of Princeton.

Another point of some interest is the fact that the entire brood of young embryos upon any one stone have their heads directed one way and toward the light, which comes in at one side of the little retreat prepared by the adults. This is very remarkable and seems to indicate that the direction whence the light comes has some influence in determining the direction in which the embryonic axis will be formed in the blastoderm.

Very active movements of the tail, and especially of the pectoral fins, begin as soon as these parts are fairly developed; these movements become more energetic toward the close of the fixed stage of existence of the young toad-fish. It is very probable that the active wriggling movements of the young embryos finally frees them from the surface to which they are firmly glued by some adhesive material secreted by the yolk-sack, but which, like that which in the first place caused the egg-membrane to adhere, is not soluble in water.

The yolk is peculiarly homogeneous and does not readily coagulate or harden in the presence of ordinary reagents, such as chromic acid, as long as the egg-membrane is intact. There are no oil-drops present and the ova are much heavier than their own volume of sea-water. The number of ova found in one brood varies considerably, but it does not seem that there are ordinarily much over two hundred laid in one place. They are dirty-yellow in color and very firm to the touch, with a very narrow space between the vitellus and enveloping egg-membrane.

The development of the toad-fish is peculiar, if not unique, in presenting a prolonged fixed stage after the period of hatching or escape from the egg-membrane is over, during which all or nearly all of the yolk is absorbed. The embryo is therefore finally set free, without being encumbered by a heavy yolk, such as is met with in the embryos of the salmon. Such a provision obviously has its advantages, especially since the young are also guarded by the male parent during the period of their helpless fixation. One

may frequently find recently hatched embryos, around the affixed pole of the yolk-sack of which shreds of the ruptured egg-membrane still adhere; during the later stages such shreds are not usually visible. There is a decidedly heterocercal tail developed from a special tail-fold, since there is no absolutely continuous median fin-fold developed, as in many other forms.

Oviposition occurs about the middle of July, in the latitude of Wood's Holl. How long it lasts has not been determined, but judging from the condition of the roes and milt of the adults at that time, it seems very probable that they do not spawn later.—*John A. Ryder.*

PHYSIOLOGY.[1]

Conditions which determine Coagulation of the Blood.—Herr Holzmann adds something to our knowledge of the conditions of blood-clotting. His results are summed up as follows: 1. A body called fibrinogen, belonging to the class of globulins, can be obtained from horse's blood, and solutions of fibrinogen neither coagulate spontaneously at ordinary temperatures nor upon dilution with water. 2. Defibrinated blood, blood serum, watery extract of the albuminous coagulum formed in blood serum by the addition of alcohol, or the extract obtained from egg-albumin coagulated in the same way, the putrescent fluids obtained from cooked egg-albumin, and long-continued passage of oxygen, all cause typical coagulation of the solution of fibrinogen at ordinary temperatures, with the production of fibrin. 3. Fibrin-ferment is not peculiar to the blood, but occurs among the decomposition products of albumin. 4. It is probable that fibrin is the product of the oxidation of fibrinogen. 5. When a dog is rapidly bled to death (one and a half to three hours), the last portions of blood drawn clot quicker than the first, though the amount of fibrin formed does not markedly vary. 6. Venous blood clots more slowly than arterial blood; suffocation delays coagulation. Curare, chloralhydrate, chloroform, quinine and soda carbonate, also delay the coagulation.

Special Physiology of the Embryo.[2]— The last of the four separately issued parts of this work having now appeared, it becomes possible to speak of it as a whole. It may be said that the author has done for the physiology of the embryo what Balfour did for the morphology in his *Hand-book.* Some of the researches described here are closely connected with those on new-born children described in the author's previous work, *Die Seele des Kindes,* to which he has frequently occasion to make reference. His most important general results are that mobility appears long before sensibility, and that the sense-organs and the parts of the

[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan.
[2] By Professor W. Preyer, Leipzig, 1885. pp. xii. 644.

nervous system connected with them are capable of functioning before it is at all likely that in normal embryonic life they have any proper functions to perform. By "mobility" is to be understood more especially the power of making spontaneous or "impulsive" movements. The presence of sensibility can only be proved by the existence of what is really a kind of mobility—that is, reflex mobility. When the appropriate reflex movements are obtained on stimulating the sense-organs it is inferred that the corresponding kind of sensibility is present. Reflex movements are not only later in appearing, but can also be made to disappear more easily than impulsive movements. The movements that indicate sensibility can be suppressed (in the artificially extracted embryo of the rabbit) by applying chloroform to the skin; with more difficulty by causing chloroform to be breathed. In either case the anæsthesia passes off very rapidly. It is supposed that the chloroform in the first case acts directly, in the second case, indirectly, on the nerves of the skin; that it only secondarily affects the spinal cord, and that it does not act at all on the brain. The movement of sensibility in the embryo gradually rises from its first appearance up to birth. In the embryo of the rabbit, the skin being irritated, two seconds may pass from the contact to the reaction. The occurrence of respiratory movements is dependent on the power already present of reflex movement in response to stimuli on the skin, not the power of reflex movements on respiration. Little has been ascertained with regard to the sense of temperature and the muscular sense; the fact that mobility is increased by warmth, diminished by cold, of course proves nothing as to the sense of temperature properly so-called. The human fœtus gives signs of having feelings of taste two months before birth. The whole complex of parts belonging to the ear is functionless before birth, as are also the parts of the eye; but the power of raising the eyelid is present; the eyes are not closed in the human embryo after the sixth month. The conditions for the organic feelings are present several weeks before birth; pleasure and pain can be distinguished. The author finally puts the question, What is the actual state of the embryo normally? He arrives by a series of arguments that seem pretty conclusive when taken together, at the result, that its state is normally like dreamless sleep or like the state of a hibernating mammal; it does not wake up from this state before birth except momentarily, and then only when strongly stimulated.—*Mind, No. xxxvii, pp. 152.*

ARE THE MUSCLES DEAD OR ALIVE DURING CADAVERIC RIGIDITY?—Professor Brown-Sequard has demonstrated that for several weeks after death, or as long as *rigor mortis* persists, the muscles of an animal undergo slow alternate contractions and elongations. The movements were only perceptable when one or the other set of a group of antagonistic muscles was divided, and they ceased totally when cadaveric rigidity finally passed away.

The movements were determined by measuring the angles through which a limb was turned, and also by obtaining on a rotating cylinder a graphic tracing representing the rate and extent of the muscular change. A dog was killed on October 6th, and on the 15th one hind limb was fastened in extension and the angular movements of the foot observed; on the 15th, the angle formed by foot and leg was 34°; on the 16th, 32°; the 17th, 16°; the 22d, 12°; the 25th, 21°; the 28th, 23°; the 30th, 18°; the 31st, 20°; November 4th, 23°. The rigidity still persisted on November 8th when the observations were described.

These movements are absolutely independent of external conditions, temperature, moisture, etc. In fact, in the same animal, while some of the rigid muscles are elongating, others are contracting and still others are at rest. Professor Brown-Sequard comes to the startling conclusion that these movements prove that the muscles in *rigor mortis* are not dead, but are still endowed with vital powers, but, however, are in a certain chemical condition which is antecedent and preparatory to final death.—*Comptes Rendus, T. ci, p. 926.*

Glandular and Vaso-motor Fibers of the Chorda Tympani and Glossopharyngeal Nerves.—Professor Vulpian has renewed after a new method his researches on this important and difficult subject. Curarised dogs were operated on in such a way that the cranial nerves could be stimulated by an induction current at their points of origin within the skull. The nerves were usually laid intact upon the electrodes; reflex effects failed, probably because the appropriate nerve centers were injured in the operation. M. Vulpian concludes that both the glandular and the vaso-dilator fibers of the *chorda tympani* leave the medulla with the facial but none of them come from the trigeminal nerve. It is certain, apparently, that the chorda tympani, besides its glandular and vaso-dilator filaments, supplies to a large extent the anterior two-thirds of the tongue with sensory nerves of taste.

Stimulation of the facial nerve at its origin causes an abundant flow of saliva from the sub-maxillary gland on the same side, but none from the parotid gland, and intense congestion of the anterior two-thirds of the corresponding side of the tongue. Stimulation of the glossopharyngeal nerve at its foramen of exit from the skull causes congestion in the posterior third of the tongue on the same side and secretion from the corresponding parotid gland. When the trigeminal nerve is excited in the same way, no secretion is obtained, nor is there any vaso-motor change in the mucous membrane of the tongue.

The geniculate ganglion is a trophic center for the chorda tympani, for, after intra-cranial section of the facial nerve, the fibers of the chorda contained in the latter remain intact while all the others degenerate.

Though not bearing directly on the present subject, it is important to observe that Vulpian has succeeded in separately stimulating near their origin both the spinal accessory and the pneumogastric nerves. Excitement of the first named alone causes arrest of the heart, while both are able to set up movements in the stomach and other organs. Stimulation of the pneumogastric seemed to have no influence upon the circulation or the secretion of the mucous membrane of the stomach.—*Comptes Rendus, T. ci, p. 851.*

PSYCHOLOGY.

THE MATERIAL CONDITIONS OF MEMORY.—The greatest possible importance attaches to the question of the physical conditions of consciousness, but the investigation of it is surrounded with great difficulties. One of the most available points of approach is by a study of the characteristics of memory. Memory may be defined as *intermittent or recurrent consciousness;* and it follows that whatever produces or destroys memory is also a cause of the appearance or disappearance of consciousness. I refer especially to reminiscence, or the recurrent consciousness of a previous impression, as that part of memory which gives it its importance in this connection.

Memory is reasonably understood to be the result of an impression made on a physical basis of consciousness by some stimulus. The structure of this matter is affected, so that on the recurrence of consciousness within it, the consciousness takes the form or character of the modified structure it finds there. Important information as to the effects of different stimuli may therefore be gained by a consideration of their relative capacities for reproduction in the reminiscent phase of memory. On this point the following propositions may be considered:

There are two sources of impressions which reappear as memories; those from the subject or subjective activities of the mind, and those from objects or things external to the mind. Before considering these, it is necessary to guard against confounding the recollection of the occurrence of an event, with the recollection or reminiscence of the sensations which constituted that event. Thus one can remember that he reached some conclusion in a given discussion, but may be unable to remember the conclusion itself. He may remember that he was angry, but be quite unable to reproduce the passion. He may remember that he had a toothache, but may be unable to reproduce the suffering itself.

Subjective stimuli are of the two classes into which all mental acts fall, the intelligent and the emotional. Objective stimuli belong to the pains and pleasures of all parts of the body, and to the special and general senses. To what extent are all these phases of consciousness susceptible of reproduction in the reminiscent part of memory? There is a kind of memory not strictly reminiscent, which may be well termed, *recognition.* The difference

between reminiscence and recognition is this. In reminiscence the peculiar form of consciousness is actually reproduced, according to the law of associated ideas; in recognition the recurrence of the original stimulus is necessary to arouse memory; otherwise the sensation would not return to consciousness. The former is evidently the stronger and truer form of memory, and as it answers our purpose best, and is most easily examined, I confine my attention to it for the present.

This much being understood, it appears to me that the following propositions may be maintained:

I. That objective impressions are less profound than subjective, the capacity for reminiscence being the index.

II. That of the objective, those introduced by the special senses are more profound than those introduced by the general senses.

III. That of the former, those introduced by supposed vibrations (sound, sight) are more profound than those produced by supposed contact of matter (taste, smell).

IV. That of subjective impressions, those produced by acts of intelligence are more readily and exactly reproduced, than are those produced by the emotions.

These propositions might be illustrated at great length, but for the present I content myself with the following:

II. The pleasures and pains of general sensation cannot be reproduced by an act of memory. No one can reproduce any particular pain for instance. It is probable that pleasures and pains which are characteristic (locality being left out of account), can be more or less *recognized* on their recurrence, showing that they make a real, but comparatively slight impression on the physical basis ofconsciousness.

III. No one can reproduce a taste or a smell with the same degree of distinctness that is possible in the case of a sound or a sight. Most persons cannot reproduce them at all. As to sounds, the reproduction is very imperfect; and although the reproduction of visible objects is, in most people, more distinct, it is short of the reality of seeing.

IV. Mnemonic reproduction of an emotion is not difficult, but falls short of the emotion itself, even in the most pronounced cases. Although emotions leave behind them deep impressions, they are plainly evanescent, in some persons more so than in others. Nevertheless a reproduced emotion is more distinctly like the original than is a reproduced sight.

Of processes of the intelligence, those of the imagination are reproduced with great precision and clearness in most persons, but not more so than processes of reason. It is only in the intelligence that it is safe to say that the reproduction or reminiscence is identical with its original. It is true that the impression may be evanescent here also, but it is less so than in the case of an

emotion. It is only in bad mental health that association fails to revive completely a process of intelligence. It is a consequence of this fact that intelligence is more cumulative in its character than emotion, and much more so than pleasure or pain. Could we reproduce in our consciousness sights, sounds and sensations as truly as we do thoughts, we would be different beings from what we are. And were they cumulative in our consciousness in the same sense that thoughts are, we would be still more different.

Thus there seems to be a relation between the nature of stimuli and their effects on consciousness, which may perhaps be formulated as follows: *The persistence of an impression on the physical basis of consciousness is in inverse proportion to its intensity in consciousness.* Thus the most violent and least permanent of impressions are molar, as in physical sensations. The intermediate are those of such special senses as are supposed to be the result of exterior vibrations. The most delicate and the permanent, are those produced by the supposed extremely rapid vibrations of living brain-tissue. These create an accustomed channel of apparently greater perfection of construction than do the more violent forms of consciousness, which are therefore longer preserved, and more readily followed by new arrivals of consciousness. The reason for this is to be found in the probable fact, which is also supported by other considerations, that the more violent forms of consciousness destroy more tissue, while the most delicate forms destroy less, rendering rearrangement more easy.

These considerations are of course applicable only to new stimuli, which are not mere repetitions of old ones, and are especially not applicable to the secondary stimulus furnished by reminiscence itself, in which are to be included dreams. That the materials of thought are often only reminiscences is no objection to the theory here presented; for the processes, and conclusions of thought are perfectly new experiences when first performed and attained. And the precision with which intelligent thoughts are reproduced is a guarantee of their persistence, since each reminiscence acts in some degree as a new stimulus. This is true of the simplest processes of intelligence in the lowest types of mind.

We can derive some hints from these considerations, as to the evolution of temporary and permanent states of consciousness.—*E. D. Cope.*

ANTHROPOLOGY.[1]

Stone Plummets.—In the summer of 1884 Mr. H. W. Henshaw spent a portion of his vacation in Southwestern California, and while there was enabled to gather some information from the Santa Barbara Indians concerning the so-called stone plummets. They have been called sinkers, plummets, sling-shots, bolas, spinning-weights, fetishes and sorcery-stones. With reference to

[1] Edited by Prof. Otis T. Mason, National Museum, Washington, D. C.

these objects Mr. Henshaw says: "The moment the stones were shown to the Santa Barbara Indians, and without leading questions from me, I was told that they were "medicine or sorcery stones," used by the medicine men in making rain, in curing the sick and in various ceremonies." This opinion is maintained by the writer. A very ingenious supplement to this theory is suggested by Mr. John Murdoch, to the effect that objects of this kind were primarily sinkers. and that handed down to their present owners they would become invested with great sacredness. Assuming this, "it would eventually follow that the groove having no longer a special function would either disappear entirely or be only slightly indicated."

POLYNESIA. — The nineteenth volume of the Encyclopædia Britannica contains an extended article by S. J. Whitmee on the Polynesian peoples. There are three different types inhabiting these islands belonging to the two distinct divisions, the dark and the brown. These three types are the Papuan, the Sawaiori or brown Polynesians and the Tarapon or Micronesians. Mr. Whitmee's table given below shows his conception of the relationship of the various groups of islands to his three types:

		Races.	*Countries where found.*
Indo-Pacific Races of Men.	Brown people: Negrito-Polynesians	Austral	Australia,
		Negrito	Andaman Is.
			Samang, etc.
		Papuan	Aru Is.
			Western New Guinea.
			Solomon Is., etc.
			New Hebrides, etc.
			Fiji.
		Sawaiori	Samoa, etc.
			Hawaii.
			Cook Is., etc.
			Society Is., etc.
			New Zealand.
	Dark people: Malayo-Polynesians	Malagasy	Madagascar.
		Formosan	Formosa.
		Malayan	Malays of Sumatra, etc.
			Java, etc.
		Tarapon	Caroline Is.
			Marshall Is.
			Gilbert Is.

The history and migrations of the Sawaiori race are discussed very thoroughly. To the names Tarapon (from *Tarawa* and *Ponape*) and Sawaiori (from *Samoa, Hawaii* and *Maori*) objections of a potent character have been raised, but it is impossible to find an aboriginal word to cover the ground, and the question is purely one of scientific priority.

ANNUAL REPORT OF PROGRESS.—The editor of these notes has for many years taken great pleasure in publishing a record of progress in anthropology for each year, with the resources at his control. The time will soon come when this work will be done

systematically and at greater length, but until that time arrives some one must do the pioneer work. The board of regents of the Smithsonian Institution have changed their year from the fiscal to the calendar, making it necessary to hand in manuscript earlier. All anthropologists are most cordially requested to send to my address the titles of all their publications.

THE "INDIAN LOCAL NAMES," recently published by a schoolteacher of York, Pennsylvania, Mr. Stephen A. Boyd, is a rather extensive collection of North American local names of Indian origin (there are but a few Central and South American names inserted), of which the interpretation is added or attempted. In an appendix we find etymologies of a number of topographic names from the Eastern hemisphere also. The undertaking is laudable, though difficult; for the compiler should not only be a copyist of etymologies given by others, but we expect him to be able to judge, which one of the ten or twelve explanations of one name is the correct one, and to do that he must have some knowledge of the language to which the name belongs. The local names of North America belong to more than 150 different dialects, and of all of these he who knows enough to pass a judgment on this matter, may fairly be regarded as the Pico de la Mirandola or the Mezzofanti of American linguistics. Mr. Boyd is not a man of this sort; for he does not even give the name of the language from which his copied interpretations are taken, and moreover we are often left the choice between three or four totally diverse etymologies of the same name. But in the preface he is candid enough to give his scientific authorities, which form quite an extensive list.—*Albert S. Gatschet.*

ANTHROPOLOGICAL NEWS.—In Vol. 106 of the Transactions of the Austrian Academy of Sciences, philol.-hist. department (Vienna, 1884), Professor Dr. Friedrich Müller has published the paradigms of several *Koloshian* (or Thlinkit) nouns and verbs, based upon data contained in a rare publication of the priest, J. Wenjaminow (St. Petersburg, 1846). Guided by the principles governing the grammar of agglutinative language in general, Professor Müller by his publication intends to rectify several statements made by Professor Dr. A. Pfitzmaier upon the same linguistic subject.——The Abnáki dialect of the Passamaquoddy river, Maine, has been made the subject of an article read before the American Philosophical Society of Philadelphia, on Feb. 6, 1885, by Abbie Langdon Alger. This article consists of a vocabulary of words, phrases and sentences, in all about 450 items on fifteen pages; the accentuation is indicated by signs of length or macrons upon the vowels. The terms are not given after certain categories of objects, as parts of body, relationships, etc., and this makes it difficult to find in the long list any word that may be looked for. It would have been pref-

erable to arrange the terms in alphabetical order.——Nearly one hundred geographic names from the State of Minnesota have been traced to their origin in the Dakota language in the thirteenth annual report of the State geologist of Minnesota, Professor N. H. Winchell (1884, pp. 104–112, 8vo). The author of the treatise, Professor A. W. Williamson, gives evidence of assiduous work in tracing the etymologies of all these village, lake and river names. The usual spelling of local names of Indian origin generally differs from their pronunciation by the Indians, which is the correct one; this Indian mode of spelling has therefore been added to each name, whenever there was necessity for it. His remark, that "most Dakotas very slightly nasalize all their vowels," must be, we think modified by adding the statement, that they do not nasalize the vowels in *every* word of the language, but in a large number of them.——Recent numbers of the Bulletin of the Torrey Botanical Club, New York, contains linguistic inquiries into the origin of plant names. Thus we find disclosures upon so-called Southern moss, Tillandsia, upon ginkgo (*Salisburia adiantiflora*), Cintractia, Savoyanne, a species of Coptis; this name is traced by W. R. Gerard, of New York, to a term appearing in several of the northern Algónkin dialects. All the above will be found in the July number of 1885. In the August number Mr. Gerard has an interesting article upon the *Indian peach*, which he states was introduced into North America both by way of Mexico and the Atlantic seaboard. The Indian equivalents are given at the close of the article.—*Albert S. Gatschet.*

MICROSCOPY.[1]

The Eye of Insects.—The following is a summary of some of the methods employed by S. J. Hickson[2] in the study of the eye of *Musca vomitoria:*

1. For making sections of the eye, it is best to dissect away the posterior wall of the cranium, and then expose it to the fumes of an osmic acid (1 p. c.) solution, 40 minutes, then to wash in 60 p. c. alcohol for a few minutes, and finally, to harden in absolute alcohol.

2. The ribbon method of sectioning can be employed with this species; but with most insects, owing to the hard chitinous cranium, it is necessary to cut, with the knife set obliquely, so as to get a long sweep at each stroke, and to remove the sections one by one.

3. The best method of depigmenting is that of exposing the sections to nitrous fumes. The sections are fixed on the slide with P. Mayer's albumen fixative, the paraffine removed with turpentine, the turpentine driven off by absolute alcohol, and then

[1] Edited by Dr. C. O. Whitman, Mus. Comparative Zoology, Cambridge, Mass.
[2] Quart. Journ. Mic. Sc., xxv, April, 1885, p. 243.

the slide inverted over a capsule containing 90 p. c. alcohol to which a few drops of strong nitric acid have been added. Copious fumes are given off, and the pigment dissolves. The action can be arrested at any moment by washing with neutral alcohol.

4. The sections are next stained with hæmatoxylin or with any other solution. The best results were obtained with hæmatoxylin made after Mitchell's[1] formula.

For teasing the best solution is chloral hydrate. The preparation is left in a 5 p. c. solution for twenty-four hours, and then teased with needles and mounted in glycerine.

Grenacher's Methods of Preparing the Arthropod Eye.[2] —*Hardening Fluids.*—Chromic acid and its salts produce a coarse granulation, and on this account must be considered objectionable. Oxalic acid, in aqueous or alcoholic solution, as recommended by M. Schultze and Steinlin, gives good results in some cases, bad in others. Picric acid gives wholly unsatisfactory preparations, while picro-sulphuric acid works well in many cases. The latter fluid, cannot, however, be used with most of the Crustacea, as here the integument contains calcareous salts which react with the acid to produce crystals of gypsum and carbonic acid, both of which work injury to the soft tissues. Merkel's chrom-platinum solution gives excellent results with some simple eyes (*e. g.* Phalangium and Acilius larvæ), but is unsatisfactory in the case of spiders and with compound eyes. Osmic acid, so highly recommended by M. Schultze, while it has some valuable qualities, is, on the whole, not very serviceable. It preserves, to a certain extent, the character of the fresh tissues, but it *renders the pigment less easily soluble*, lessens important differences in refrangibility (*e. g.* between the rhabdomeres and the protoplasm of the cells), and besides leaves the preparation brittle, so that good sections are not easily obtained.

The most serviceable hardening fluid for the compound eye is alcohol (70 p. c.–90 p. c.). The hyaline rhabdomeres generally remain clear and transparent, but lose their color and often a part of their refrangibility.

Bleaching.—The pigment is dissolved very rapidly by caustic potash, but this agent destroys almost equally rapidly other parts, even to the chitinous parts. The strength first recommended by Moleschott, 30–35 p. c., allows time for examination in detail. The best means of bleaching is found in nitric acid, first recommended for this purpose by Gottsche[3]. Gottsche used the full strength, M. Schultze, 25 p. c.; Grenacher employed 20–25 p. c., adding a drop to the sections lying in dilute glycerine, under the cover-glass. The demonstration of nuclei by means of the ordi-

[1] The Science Monthly, March, 1884.
[2] "Das Sehorgan der Arthropoden," p. 22–25, 1879.
[3] Mül. Arch. 1852, p. 486.

nary dyes, after the use of nitric acid, is very difficult. This can be accomplished, however, in the following simple way: Add only a trace of nitric acid to the prepared section, and leave it 12–24 hours. The pigment dissolves slowly, and is taken up by the nuclei, and thus acts as a stain. The preparations are not beautiful, but are quite clear and distinct, and can be mounted without danger of disturbing the pigment. A similar proceeding (pigment dissolved by acetic acid) has been described by Leydig.[1]

The following is another mixture employed by Grenacher, as given by Carrière:[2]

Glycerine	1 part.
Alcohol (80 p. c.)	2 "
Hydrochloric acid	2–3 p. c.

The preparations remain in this mixture until the pigment changes color and becomes diffuse.

Method of Examining the Reflex in the Compound Eye of Insects.—Lowne[3] recommends the substitution of a reflecting ophthalmoscope for the eye-piece of a microscope. "By this means a bright luminous spot may be observed as a real image in the tube of the instrument. A quarter objective must be used, and the mirror of the ophthalmoscope must be strongly illuminated. The microscope is then focused so that a real image of the corneal facets is seen between the objective and the eye of the observer. By bringing the object-glass gradually nearer to the insect's eye the reflex will come into view. The reflex appears as a disk having a fiery glow, in moths, and as a bright ruby spot in the cabbage butterfly. Sometimes six spots, surrounding a central spot, are seen in the eye of the insect; perhaps these are diffraction-images. A similar appearance is seen when the eye of this insect is observed by the naked eye, except that the spots are black. * * * The reflex seen with the micro-opthalmoscope is green in Tipula, and bright yellow in the diurnal flies. Colored diffraction-fringes are usually present around the central bright spot in both these insects; but the central image is sometimes surrounded by a perfectly black ring."

"The manner in which the luminous reflex scintilates is very suggestive of an alteration in the focal plane of the dioptric structures under the control of the insect."

The color of the reflex obtained is supposed to depend on the color of the fluid contents of the "spindle" ("Rhabdom" of Grenacher), while the reflex itself is due to reflection from the spindles, which, in moths, are surrounded by very close parallel tracheal vessels, which form a very perfect reflector.

The reflex disappears very quickly even in diffused daylight,

[1] Auge der Gliederthiere, p. 41.
[2] Die Sehorgane der Thiere, p. 205, 1885.
[3] Trans. Linn. Soc. Lond. Second Ser., Zoology. Vol. II. Part 2, p. 406–7. Dec., 1884.

but can be restored by keeping the insect in the dark for half an hour. The disappearance of the reflex in the light is due to the contraction of the pigmented iris cells.

METHOD OF ISOLATING THE DIOPTRIC LAYERS OF THE COMPOUND EYE.—Gottsche[1] was the first who succeeded in isolating the whole dioptric portion of the compound eye, so that the corneal facets and the cones could be examined *in situ*. The isolation of the corneal layer alone is more easily effected; this had already been accomplished by Leeuwenhoek, Baker, Brants and Gruel, who examined with the microscope the images produced by the corneal facets.

Gottsche took the eye of a fly, and separated the inner wall, so that only the cornea with the optical apparatus remained. Holding the cornea fast by one end, he next removed the red portion of the eye, *i. e.*, the retinulæ. These break off at the inner ends of the cones, leaving the cornea with the cones intact. The preparation is next laid on a slide with the convex side of the cornea down (there should be just glycerine enough beneath the cornea to make it adhere to the slide). A cover-glass is then placed over the preparation, with care to leave the concave upper side filled with an air-bubble. Slight pressure on the cover-glass will usually be found sufficient to create the air-bubble. If no undue pressure has injured the cones, the preparation is now ready for examination with the microscope. The tube of the microscope may now be placed so that the hexagonal facets are in focus, and then raised until the inner (upper) ends of the cones become visible, but not sharply focused. If any object, *e. g.*, a steel pen, is now held between the mirror and the preparation, a minute inverted image of the same will be seen in each facet.

Grenacher thinks the contents of the cones ("pseudocones") would escape by Gottsche's method, so that the experiment would really amount to no more than that of Leeuwenhoek, Baker, &c.

Grenacher (Das Sehorgan d. Thiere, p. 148), taking the eye of acrepuscular or nocturnal moth that had been hardened in alcohol, cuts off a section with a sharp knife, places it on a slide with the convex corneal surface below, and then removes the pigment by a careful use of nitric acid. With this preparation he repeats the experiment of Gottsche, and finds that the images fall not behind nor in the ends, but near the middle of the crystal cones. This position of the images, at points where there are no percipient elements, is held by Grenacher to be fatal to the view that they are seen by the insect. According to Lowne's[2] view, the retinulæ constitute a second refractive system which serves to magnify and erect the images formed within the cones, so that the whole visual field consists of a mosaic of erect images.

[1] Mül. Arch., 1852, p. 488, 489.

[2] Trans. Linn. Soc. Lond., p. 389. Dec., 1884.

He places the retina behind the basilar membrane, precisely where it was supposed to be by Gottsche.

THE SAC-LIKE NATURE OF THE WINGS OF INSECTS.[1]—Mr. G. Dimmock showed the two halves of a split wing of *Attacus cecropia*, in which the two layers of the wing had been separated by the following mode: The wing from a specimen that has never been dried is put first into seventy per cent alcohol, then into absolute alcohol, and from the latter, after a few days' immersion, into turpentine. After remaining a day or two in turpentine, the specimen is plunged suddenly into hot water, when the conversion of the turpentine into vapor between the two layers of the wings so far separates these layers that they can be easily parted and mounted in the usual way as microscopical preparations on a slide.

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SCIENTIFIC NEWS.

—No glaciers exist in the United States but those of the Pacific coast, as only here the atmospheric conditions are favorable, and the ice-streams of Mt. Hood are the only ones on this coast easily reached. Down far below the snow line, great seas of ice push their way through valleys they have cut for themselves. Their downward motion varying in speed with the slope of the channel and the weight of snow above, is constant—a few inches a day. The lower part is ice, higher, icy-snow; and where there is little thaw, pure snow. The fields of the ice are strewn with unassorted debris, from bowlders weighing tons, to the finest sand which falls from the walls of the glacier valley. Near the foot of the glacier the rubbish is twelve inches or more thick, while in other places one can walk over nearly bare ice—aye, can travel for miles and study moraines, crevasses, ice wells, caves, ice tables and all the appurtenances of a first-class glacier without guide or alpenstock, ropes, or spiked shoes. The ice moves as only ice can, moulding itself to variations in the channel, and splitting across to form crevasses only when meeting some great descent in the bed. Melting extends up over the surface as well as at the base; the traveler steps across streamlets flowing upon the ice surface toward the base, perhaps to lose themselves in crevasses further down; and from the wedge-shaped snout of the ice giant pours a deluge of water, while down its face rains a shower of sand and rocks. The water assorts the debris, soon dropping the bowlders, carrying the coarse sand further, and bearing to the Columbia much of the ashy sand that is filed off by the bottom of the glacier.—*Portland Oregonian.*

— Professor W. A. Rogers, of the Harvard Observatory, has reported to the American Academy of Arts and Sciences, in Bos-

[1] G. Dimmock, Pysche, May, 1884, p. 170.

ton, the results of his observations on the transmission of shock from the Flood rock explosion.

The air-line distance between the observatory in Cambridge and Flood rock is 190 miles, and the observations were timed as follows: Disturbance first seen, 11.17.14; instant of maximum disturbance, 11.18.03; disturbance ceased, 11.20.

The first vibration perceived was about a thousandth of an inch, and recurred at intervals for nearly two minutes, the greatest swaying of the mercury being over a space of one five-hundredth of an inch.

In this connection it is interesting to note that General Abbot reported that the shock from 50,000 pounds of dynamite, exploded in 1876 at Hallet's Point, was transmitted through the drift formation of Long Island, at the rate of 5300 feet per second for 13½ miles. Assuming the figures of the Cambridge report as correct, and that the mine at Flood rock was exploded at 11.14, seventy-fifth meridian time, it took the wave just 194 seconds to travel 190 miles, or at the rate of 5120 feet per second. This is very near the rate of transmission observed by General Abbot, when the greatly increased distance is taken into account.—*Exchange.*

— While M. Pasteur, at his country retreat, has been developing a means of combating the spread of hydrophobia, alarmist notes have been sounded in the public press. There can be no doubt that hydrophobia is on the increase, and will continue to increase until the owners of dogs are sufficiently educated to recognize the preliminary symptoms of rabies. A dog that slobbers with hanging jaws, and barks unnaturally, should be destroyed. Dumb rabies is the most dangerous, perhaps, because the animal, while retaining a knowledge of his master and friends, is apt to be snappish, and bite without warning. Cauterization of such wounds is practically of little value, and the best thing that can be done is to suck the wound forcibly, so as to draw as much blood and fluid from the part as possible. At Monday's sitting of the Paris Academy of Sciences, M. Pasteur read a long paper on this subject, and furnished proofs that his methods of inoculation had cured hydrophobia, and was easily practicable. Dr. Vulpian corroborated, from personal observation.—*English Mechanic.*

— The second division of the Zoölogischer Jahresbericht für 1884, edited by the zoölogical station at Naples, and now published at Berlin by R. Friedländer & John, has appeared and is devoted to the Arthropoda. It can be purchased separately, as can the other three parts. The present part is edited by Drs. Mayer and Giesbrecht.

— Carl von Gumppenberg, of Munich, is preparing a monograph of the geometrid moths of the northern hemisphere, and

would like to receive from American entomologists copies of their papers containing descriptions of new species of this group issued since the publication, in 1876, of Packard's monograph of American geometrids.

— The lecture course of the New York Academy of Sciences opened on December 14th, by a lecture on the genealogy of the Mammalia by Professor E. D. Cope. The next lecture will be January 11th, 1886, by Professor E. S. Morse, on Prehistoric Man in America.

— Professor Joseph Prestwich has a treatise on geology in the Clarendon Press. He advocates non-uniformitarian views of geology.

— Professor H. Weyenburgh died at Haarlem, July 25. He was professor of zoölogy in the university of Cordova, Argentine republic. He did a great deal for progress in his science, and of a set of thorough-going entomologists in that country he was chief.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

THE INTERNATIONAL GEOLOGICAL CONGRESS, at Berlin, Sept. 29th to Oct. 3, 1885.—The third and most important session of the International Geological Congress, which was instituted by an American committee of the A. A. A. S., at its Buffalo meeting in 1876, has just been held.

The first session at Paris, in 1878, was really a *pourparler* which broke ground. The next session at Bologna, in 1881, accomplished something, but was especially useful in preparing for the work of the session just closed by deciding to produce a geological map of Europe on a scale of $\frac{1}{1500000}$, and entrusting its execution to one committee, while another was appointed to devise some scheme for unifying the nomenclature and, where possible, of fixing the limits of various congeries of beds which had heretofore been differently understood by different geologists. The obstacles which faced these committees will be at once understood from this bare statement and will modify any hasty impression that, in fact, very little has been accomplished.

The two committees, or a majority of members of each, met at Foix, and at Zurich, during the four years which intervened between the Congresses of Bologna and Berlin, and the action of the congress which has just ended was almost exclusively confined to the propositions made in the printed reports of these committees.

Those who arrived in Berlin some days before the opening of the congress found, at the superb Bergakademie on the Invaliden

strasse, a bureau organized to examine the credentials of delegates and provide each with the necessary card and receipt for the ten marks cotisation, besides a medal in silver bearing the inscription on one side: "Geologorum Conventus. Mente et Malleo," with the conventional schlägel und eisen crossed and surrounded by a wreath of oak. On the other side, within a similar wreath were the words: "Berlin, 1885." The medal was suspended by a white satin ribbon and worn on the lapel of the coat for identification on excursions, etc.

A programme of the order of events may be thus condensed: Monday, Sept. 28, at 10 A. M., meeting of the council at the Reichstagsgebäude; 5 P. M. social reunion of the members of the congress in the ante-chamber of this palace. Tuesday, Sept. 29, 11 A. M., opening of the congress; 2 P. M., visit to the Bergakademie to view the collections and the objects sent to the congress. Wednesday, Thursday, Friday and Saturday, sitting of the congress at 2 P. M. 7 P. M. Saturday, close of the congress. Sunday, 9 A. M. excursion to Potsdam. Then followed announcements of the excursions to the Hartz, to Stassfurt, etc. This programme was followed in the main, only an extra session of the congress being intercalated. The usual course was to devote two hours to the discussion of the committees' reports (2 to 4 P. M.), and the last two hours (4 to 6 P. M.) to scientific discourses of various delegates.

The weather during the entire week was very disagreeable, cold and rainy. On Sunday morning after the close of the congress, it promised to be fair, but only to deceive the hopes of those who took part in the Potsdam excursion. The commencement of this trip was very beautiful, but towards the close it degenerated into a procession of dripping and shivering people who tried to look as if it were pleasant in order not to offend their kind hosts.

The language of the congress had been decided upon as French, and this, no doubt, accounts for the greater share taken by the Swiss, Belgians, and French in the debates, than by the people of other nationalities. The Germans, for instance, who outnumbered all other nationalities taken together several times over, had only one representative who managed the language with fluency and led in debate—M. Hauchecorne, the active spirit of this congress. It is true that M. Neumayer retorted very effectively once to M. Lapparent, and his excellency v. Dechen spoke frequently, if not easily; but Dr. Beyrich, the nominal president, was entirely unintelligible, and M. Stur was obliged to get a dispensation from the congress and speak in German.

Report of Proceedings.—On Tuesday evening at 6 o'clock, M. Renevier, of Switzerland, the secretary of the committee appointed to prepare the European map, with a few preparatory words explaining that what he was about to read did not emanate from him but from the committee, presented this report.

The committee appointed to prepare the map was thus constituted: Beyrich and Hauchecorne (formerly the sub-committee of direction in Berlin), Germany; Daubrée, France; Giordano, Italy; de Mœller, Russia; Mojsisovics, Austro-Hungary; Topley, Great Britain; Renevier (secretary general), Switzerland. The committee of direction had made an arrangement with D. Reimer & Co., of Berlin, according to which this firm agreed to undertake the publication of the map at its own risk, provided the committee would guarantee them an edition of 900 copies at 100 francs a copy, and would advance them sums on account.

The map is to consist of forty-nine sheets—7 in breadth and 7 in height. Each of these sheets is 48 by 53 ^{cm} and the whole of them together will form a chart 3.36 meters high and 3.71 meters broad. Professor Kiepert, of Berlin, is to prepare the topographic base, using for the purpose all data at his disposition, both published and unpublished. Great Britain, France, Spain, Italy, Austro-Hungary, Germany, Scandinavia, and Russia, each takes 100 copies = 800. The remaining 100 copies are to be divided between the six smaller States, Belgium, Holland, Denmark, Switzerland, Portugal, and Roumania. The central committee is to receive from each national committee the maps of its country and to make them harmonize.

The report ends with the following six resolutions, which the committee asked the congress to pass:

I. M. Karpinski will succeed M. de Moeller (resigned), in representing Russia on the committee.

II. The *Carbonic* system (or Permo-carboniferous) shall be represented on the map by three distinct shades of gray.

III. Brown shades will be applied to the "*Devonic.*"

IV. The color to represent the "*Siluric*" is left to the discretion of the committee.

V. The eruptive rocks shall be represented by seven tints ranging from bright red to dark-brownish red.

VI. The determination of the other questions mentioned in the report shall be left to the discretion of the committee.[1]

Proposition I was adopted without dissent.

Proposition II after much opposition was agreed to with the understanding that the proposed method of the committee should not be understood to have any bearing on the scientific settlement of the question, but should be regarded purely as a provisional expedient adopted in order to complete the map.

Proposition III was agreed to.

[1] The questions here referred to, comprise several matters about which the committee was in doubt, e. g.: *a.* How are the terranes to be represented, of which the subdivisions were doubtful? *b.* How are those subdivisions to be indicated which are too small to appear on the adopted scale of $\frac{1}{1500000}$? *c.* How are measures to be represented when even their age is doubtful? How represent subdivisions concerning the affiliations of which geologists differ (Gault, Rhetien, etc.).

Proposition IV, after strong opposition from Professor Hughes and M. Jacquot, was finally so modified as to allow the committee to adopt it provisionally for the purposes of the map without prejudging abstract scientific questions at all, and thus carried.

Propositions V and VI were carried without objection.

Sept. 30, 1885, at 2.30 P. M., the congress reässembled to take action on the report of the committee on the unification of nomenclature which was then presented by M. Dewalque.

The reading of this report, which was much longer than the other, was taken up at p. 13, A.

The thirteen pages of the report thus skipped had been in the main adopted at the Bologna Congress, a few minor points having been left for future adjustment. They concerned for the most part definitions of terms such as "group," which it was advised should be applied to the division of the highest order (*e. g.* secondary *group*, etc.); the next division should be *systems* (Devonian *system*, etc.); the third should be *series* (*e. g.* the coal measures *series* of the Carboniferous system); the fourth division should be *stages* ("étages") (millstone grit, *stage*, etc.); the division of the fifth order was decided upon for French only, "*assise*" or "*couches*." "*Zone*" should be used for a number of beds having one or more fossils to characterize them, but it should be inferior as an order of classification to "*stage*." "*Bank*" was selected to imply a bed (couche or assise), thicker or more coherent than those in its vicinity, among which it is intercalated. These and certain conclusions as to the application of the terminations "ary," "ic," and "ian"—the first for the groups, the second for the series, and the third for the stages—completed the linguistic portion of the report. It is to be observed that no adjective termination to precede system was proposed.

The remainder of the report, unacted upon, concerned subjects partly implied in the later portions.

Archæan.—It was decided to give to the Pre-palæozoic rocks the name Archæan instead of Primitive, and while recognizing three divisions to allow each geologist to distinguish them by petrographic characters.

Silurian.—On the motion of Professor Archibald Geikie, the decision as to the limits of the Silurian and Devonian is left till the meeting of the congress in London in 1888, but the committee on the chart has liberty to divide the lower system of the Palæozoic group into three parts of which the names will be determined upon later.

Devonian.—After a long and exciting discussion, it was proposed: *a.* That the Devonian should be divided into three parts corresponding respectively with those termed the Rhenan, the Eifelian, and the Famennian. *b.* That the calceola beds should form part of the Eifelian. *c.* "That the upper limit of the Devonian should be drawn at the base of the Carboniferous limestone, that is to

say, the system which includes the psammites of Condroz and the upper Old Red" [the words "the Lower Carboniferous (Kilborkan, Marwood, Pilton)" and "or the calciferous sandstone Dura Den" were stricken out of the committee's resolution at the request of Professor A. Geikie as not representing the real associations of these beds].

Carboniferous.—The question of associating the Permian with the Carboniferous provoked the most interesting discussion of the congress, Stur of Vienna, Lapparent, Blanford, and Professor Newberry spoke in favor of such union. Hughes, Topley, Nikitin, and a great many others spoke against the association. Professor Newberry in the course of his remarks, said that "his honored colleague, Professor Hall, was of the opinion that the Permian did not exist in America, and that his own studies confirmed this view." M. Neumayr thought "the decision of such questions as this should not depend upon a majority vote which would change in each country, and after each eloquent speaker (referring to M. Lapparent's brilliant defense of the committee's proposition). This view was finally taken, and the congress adopted, with about fifteen dissenting votes, the following proposition formulated by M. Dewalque:

"The congress not wishing to pronounce an opinion on the scientific question will leave the classification as it is."

Triassic.—After much debate the three-fold division of the Triassic was agreed to, but without giving names to the divisions.

Jurassic.—The division of this system into three was adopted, but without specifying the names of the divisions.

It was agreed that each geologist might draw the upper horizon of the lias where he thought best.

Cretaceous.—It was agreed that the Gault should be joined to the Cretaceous.

Tertiary.—The divergence of views on this subject was so great that M. Capellini then in the chair, cut short the whole question by asking for a vote of confidence in the committee, which was unanimously given.

Eruptives.—Finally the seven-fold division of the eruptive rocks, in as many tints of red, was carried without opposition.

This completed the serious geological work of the congress, and it was then agreed to meet in London in 1888. A committee consisting of Hughes, Geikie, Blanford and Topley was appointed to make the necessary arrangements, and the congress adjourned.

During the course of the congress addresses were given by M. Gaudry on certain reptiles; Newberry, on a new large Devonian fish from America; Posepuy, on the fluid condition of the earth's interior; Ochsenius (in German), on the origin of salt deposits; Neumayr, on the plan for the "nomenclator palæontologicus," which he is compiling (and which the congress voted to publish under its auspices and through the agency of a special committee consisting of MM. Gaudry, Zittel, and Neumayr); M. Nikitin

presented his map of the Middle and Southeast Russia, including the valley of the Volga; M. Vasseur, thirteen sheets of the map of France; and Dr. Frazer, on behalf of Mr. McGee, presented an explanation of the methods employed by the director of the United States Geological Survey.

The delegation which represented the United States at this congress consisted of Professor James Hall and Professor J. S. Newberry, members of the original committee which suggested the congress; Professor D. Ph. H. S. Williams and Professor D. Sc. Persifor Frazer, who were elected by the American Association for the Advancement of Science at its Ann Arbor meeting. Besides this, Professor Brush was elected by the committee under the powers granted to it. Mr. J. F. Kemp (assistant to Professor Newberry), Mr. H. B. Patton (student), and Mr. H. E. Miller (chemist), from America, also appeared on the roll of the congress. The last two named were not known to the secretary, who cannot say whether or not they attended the sittings. Mr. McGee, representing Maj. Powell and the U. S Geological Survey, arrived after the sessions had commenced.—*From Science, Oct. 30, Persifor Frazer, Secretary of the American Committee delegates.*

[*Note.*—A more detailed report, giving the debates in part, will appear shortly in the *Am. Journ. of Sci. and Arts.* In *Science* for Dec. 11, Professor Dewalque does not agree as to the action on paragraph *C. c.* under the Devonian. I am sorry not to feel authorized to change it. Several members of the congress think that the action was as above stated.—*P. F., Dec. 15, 1885.*]

National Academy of Sciences, Albany, Nov. 10–12, 1885. —The following papers were presented: Obscure heat, by S. P. Langley; A new form of craniaphore, for taking composite photographs, by John S. Billings; The carboniferous xiphosuran fauna of America, by A. S. Packard; Stellar photography, by E. C. Pickering; Two new forms of polyodont and gonorhynchid fishes, from the Eocene of the Rocky mountains, by E. D. Cope; Yale College Observatory, New lines on the spectra of certain stars, by O. T. Sherman (by invitation); Certain stars observed by Plamsteed, and supposed to have disappeared, by C. H. F. Peters; Remarks upon the international geographical congress at Berlin, with a brief historical notice of the origin of the congress, by James Hall; Notes on some points in the geology of the Mohawk valley, by James Hall; When shall the astronomical day begin? by Simon Newcomb; Primordial rocks among the Waffinger valley limestones near Poughkeepsie, N. Y., by William B. Dwight (by invitation); The errors of star catalogues, by C. H. F. Peters; Preliminary report on the investigation relating to hereditary deafness, by A. Graham Bell; The new star in the nebula of Andromeda, by C. A. Young; Recent progress in economic entomology, by J. A. Lintner (by invitation); Remarks on the stone ruins of the Colorado and the Rio Grande, by J. W. Powell;

The New York State herbarium, by Charles H. Peck (by invitation); The formation of a polar catalogue of stars, by T. H. Safford (by invitation); A section through the southern tertiaries, by Otto Meyer (by invitation); Remarks upon the Lamellibranchiate fauna of the Devonian rocks of the State of New York, and the results of investigations made for the palæontology of the State, by James Hall; Recent discoveries of gigantic placoderm fishes in the Devonian rocks of Ohio, by J. S. Newberry; The flora of the Cretaceous clays of New Jersey, by J. S. Newberry.

ACADEMY OF SCIENCES OF INDIANA.—The preliminary circular proposing the formation of a State Academy of Science of Indiana, issued by authority of the Brookville Society of Natural History, has elicited such a general response in favor of the movement that there has been issued a circular calling a meeting of all of the people of Indiana interested, to be held in the criminal court room (Hall of Representatives) of the Marion county court house, at Indianapolis, Ind., on Tuesday, December 29, 1885, at 2 o'clock P. M.

In order that a proper understanding may be had of the present state of scientific study in Indiana, it has been thought advisable to ask from competent authority a statement of the present condition of each branch of science that is being studied within the borders of our State. The following persons have kindly consented to present papers upon the several subjects mentioned.

Richard Owen, M.D., Sketch of the work accomplished for Natural and Physical Science in Indiana; David S. Jordan, M.D., Icthyology; Professor John M. Coulter, Botany; Professor J. P. Naylor, Physics; R. T. Brown, M. D., Geology; Professor O. P. Jenkins, Lower Invertebrates; E. R. Quick, Mammalogy; Professor Robert B. Warder, Chemistry; Professor O. P. Hay, Herpetology; Daniel Kirkwood, LL.D., Astronomy; P. S. Baker, M.D., Entomology; Maurice Thompson, Mineralogy; Rev. D. R. Moore, Conchology; Sergeant Orin Parker, Meteorology; J. B. Conner, Statistics; A. W. Butler, Ornithology.

NEW YORK ACADEMY OF SCIENCES, Nov. 9.—The following paper was presented: Description of some gigantic placoderm fishes recently discovered in the Devonian of Ohio (with illustrations), by Dr. J. S. Newberry.

Nov. 16.—The following paper was read: The rise and progress of invertebrate Zoölogy, by Dr. J. B. Holder.

Nov. 23.—The following paper was read: The preservation of building materials by the application of paraffine, as recently used upon the obelisk (illustrated with apparatus and experiments), by Mr. R. M. Caffall.

Nov. 30.—The following papers were presented: On meteoric irons (1. From Glorieta mountain, Santa Fé county, New Mexico; 2. From Jenny's Creek, Wayne county, West Va.), by Mr. Geo. F. Kunz; Minerals of Harlem and vicinity, by Mr. B. B. Chamberlin.